THE DERBY HORSE RAILWAY AND THE WORLD'S FIRST ELECTRIC FREIGHT LOCOMOTIVE

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NEW HAVEN COLONY HISTORICAL SOCIETY

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Cover photograph: A series of photographs was taken of the Derby Horse Railway in operation soon after its opening on May 1, 1888. Here, car No. 2 is shown southbound on Derby Avenue in Old Derby, at Mt. Pleasant Street (Prospect Avenue on the 1888 map). Note the arc light mounted on a pole in the middle of the picture. The houses shown still exist in somewhat altered condition. (*Hall Collection, B.E.R.A.*)

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Background

The first public demonstration of an electric railway took place at the Berlin Trade Exhibition in May 1879. Thousands of visitors were carried on the diminutive, locomotive-hauled train on its one-thousand-foot loop of narrow-gauge track. The little train was subsequently demonstrated in a number of European cities. The first American demonstration of an electric railway was carried out by Thomas Alva Edison in 1880 at his Menlo Park laboratory in New Jersey. The locomotives used on both of these pioneer electric railways have been preserved. (See *Highlights in the Development of Electric Railways.)*

The electric railway was developed concurrently in Europe and America. The German firm of Siemens & Halske took an early lead, but once American innovators put their minds to solving the problems involved, they rapidly caught up with, and then overtook, their European competition. In the nine years following the Berlin Trade Exhibition demonstration, the electric railway—as applied almost exclusively to street railways—was developed to a practical state, culminating in the opening of the Richmond Union Passenger Railway, at Richmond, Virginia, through the great efforts of Frank J. Sprague and his associates.

In the October 1888 issue of the *Street Railway Journal* a list of electric railway installations in the United States and Canada at that time included the Derby Horse Railway with its electric freight operation that had been equipped by Charles J. Van Depoele. Thirty-eight cities and towns had electric street railways, of which the largest and most advanced was the aforementioned line in Richmond. This line had twelve miles of track and forty electric streetcars.

Just a year earlier, in a *Street Railway Journal* list of electric railways, only twelve such lines were reported to be in operation, six of them installations of the Van Depoele Electric Manufacturing Co. of Chicago. The largest of these, at Montgomery, Alabama, had twelve miles of track and fourteen motor cars. It was the first citywide electric streetcar system in the world.

William J. Clark (1854-1922) of Birmingham (now Derby), Connecticut, was one of the incorporators of the Derby Horse Railway, and it was he who obtained the legislative charter that authorized its construction as an electric railway. His interest in electricity was inspired by William Wallace of Ansonia, the American pioneer in the manufacture of electric arc lighting equipment. Clark's knowledge of Van Depoele's electric railway installations was undoubtedly the reason that Van Depoele's firm was awarded the contract to electrify the Derby Horse Railway. Van Depoele needed better financing to work on his electrical inventions, and in sympathy with this need, Clark—who knew Frank Sprague, then at work on the Richmond Union Passenger Railway electrification—tried to persuade Sprague to take over Van Depoele's company. Sprague was not interested.

He was preoccupied with many problems on the Richmond job, and in any event was not too impressed with Van Depoele's expertise.[1]

In a 1915 article about the Derby Horse Railway's electric locomotive,[2] and in a biography of Clark published in 1919,[3] a story is told that Clark went to the Thomson-Houston Electric Co. of Boston, which he had found to be interested in expanding into the electric railway field. This firm had already made a small start in this direction by manufacturing streetcar motors for the Bentley-Knight firm. The Thomson-Houston Co., through Clark's intercession, was pleased to purchase Van Depoele's electric railway patents. Among the most important of them were the ones for the under-running current collection system (trolley wheel and pole).

The story of Clark's role in introducing Van Depoele to Thomson-Houston is contradicted in other publications. Yes, Thomson-Houston was indeed interested in entering the electric railway field. Elihu Thomson recommended to Charles Coffin, the chief executive of Thomson-Houston, that they develop their own electric railway system "in house." In order to shorten the developmental period, Coffin preferred to acquire existing patents and asked Thomson to recommend a system that had the features most advantageous to them. Thomson recommended the Van Depoele system, and an approach was thereupon made to Aaron Stiles, general manager of Van Depoele's company, for the purchase of the electric railway patents.[4]

Which of these versions is accurate? The Coffin version seems more probable, but surely there is an element of truth in the story of Clark's involvement, and one would like to believe it, as it ties in so directly with the story of the Derby Horse Railway.

In March 1888, Van Depoele moved to Lynn, Massachusetts, to work at the plant of the Thomson-Houston Co.; Clark became the northeastern sales representative for the company—in later years he was the head of the Electric Railway Division of the General Electric Co. With the aid of Van Depoele's valuable patents and Clark's expertise, the Thomson-Houston Co. was soon in the forefront of electric railway development.

In 1889, the Sprague Electric Railway and Motor Co. and the Thomson-Houston Co. dominated the electric railway industry. The trade publication *Electrical World* in October 1889 provided the following statistics to illustrate the rapid progress of electric railways: 180 electric street railways had been built or were under construction, totaling 1,260 miles of track and almost 2,000 cars. Sprague and Thomson-Houston had each installed 67 lines, and 10 were credited to Van Depoele. Another 36 lines had been equipped by Leo Daft, Bentley-Knight, and others.

With ample development capital at its disposal and its own manufacturing plant, the Thomson-Houston Co. became the leader in the electric railway field. Following the test lines equipped by Sprague, Bentley-Knight, and Thomson-Houston for the West End Street Railway in Boston, the Thomson-Houston Co.

secured the electrification contract for the system, which was the largest street railway under one management in the world. A Thomson-Houston catalog issued about 1890 stated that the Sprague and Bentley-Knight equipment had been discarded on the West End Operation.

The streetcar motors of the Sprague company were manufactured by the Edison Machine Works at Schenectady and were the largest part of the electric motor production of that company. In 1889, the newly formed Edison General Electric Co. absorbed the Edison Machine Works. It also took over the Sprague Electric Railway and Motor Co. through the ownership of a controlling block of its stock. For a short time Frank Sprague was an employee of Edison General Electric, but because of philosophical disagreements with the management, he soon left the company to find new worlds to conquer. Incidentally, Sprague had worked for Thomas Alva Edison's electric lighting company in 1883-84. Edison disliked Sprague, but his employment by Edison resulted in Sprague's forming a friendship with Edward H. Johnson, who was the head of the Edison Machine Works. Sprague and Johnson formed the Sprague Electric Railway and Motor Co., and as mentioned previously, the machine works manufactured most of Sprague's motors.

In the early part of 1892, the Edison General Electric Co. and the Thomson-Houston Electric Co. combined to form the General Electric Co. At very nearly this same time, Charles Van Depoele died at the relatively early age of forty-six. Major competition to General Electric also emerged in the form of the Westinghouse Electric and Manufacturing Co., which quite early began the production of well-designed streetcar motors.

The first streetcar motor produced by General Electric was the 27-horsepower GE-800. It was the first fully enclosed, waterproof traction motor and was placed on the market in 1893. It quickly became a best seller. An early application of two of these motors was to power the Chapel Street swing bridge in New Haven in 1898. In 1987, the original GE-800 motors are still rotating this bridge after almost ninety years' of use.

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3. Thomas Commerford Martin and Stephen Leidy Coles, eds., *The Story of Electricity,* vol. 1 (New York, 1919), p. 162.

4. Harold C. Passer, *The Electrical Manufacturers 1875-1900* (Cambridge: Harvard University Press, 1953), p. 249.

Map showing the lines of the Derby Horse Railway and the Birmingham and Ansonia Horse Railroad. From an area directory published in 1888. *(Derby Public Library)*

The Derby Horse Railway— Connecticut's First Electric Railway

The Derby Horse Railway was incorporated under the laws of the State of Connecticut on March 19, 1885. It was empowered to build a horse railway line from Upper Ansonia, along Main Street on the east side of the Naugatuck River, south along Derby Avenue to Old Derby. From this point it was to run westward across the river and along Main Street in Birmingham,[1] ending at Caroline Street. The charter was subsequently amended to substitute electricity for horsepower and to permit the haulage of freight. The man responsible for organizing this project was William J. Clark, who with his father and brother operated a coal business in Birmingham and who in 1879 had been appointed postmaster of Birmingham. His biography states that he "obtained the first legislative charter authorizing the construction of the first electric railway in the world intended for freight traffic."[2] On June 29, 1889, the Derby Horse Railway was renamed the Derby Street Railway. It became part of the Connecticut Railway & Lighting Co. in December 1900.

Ansonia was the site of considerable industrial and commercial activity in the nineteenth century. One of the principal manufacturers located there was Wallace and Sons, who produced copper and brass wire and tubing. William Wallace (1825-1904) was, along with Clark, one of the incorporators of the Derby Horse Railway. In the 1870s he was the first American manufacturer of an electric arc light system, which was developed in collaboration with Professor Moses Farmer (1820-93). Although by 1880 other firms had come to dominate the electric light field, Wallace maintained an interest in technological developments in the electrical field. He probably influenced the choice of an electric powered railway, but there is no evidence of how extensively he did so.

Another principal in the Derby Horse Railway was Col. H. Holton Wood (1859-1912), who also had an interest in electricity. He had been manager of the Staten Island Rapid Transit Co. until it was taken over by the Baltimore and Ohio Railroad. Arriving at Birmingham in 1887, he purchased an interest in the charter of the Derby Horse Railway and soon afterward became its president. He also established the Naugatuck Valley Steamboat Co. to carry freight and passengers from Derby dock to New York's Pier 39 on the East River.

The electric railway would terminate at the steamboat wharf, thus providing freight service from Ansonia to New York. Ansonia manufacturers like Wallace and Son felt that the existing railroad freight rate of $2 a ton was too high. As an alternative, the electric railway with its steamship connection would substantially reduce the cost of shipping goods into and out of the area. The steamship company bought two vessels, the *Housatonic* and the *Ruggles*, and had a fine new steel-hulled, twin-screw ship, the *Naugatuck*, built for the service. The *Nau-*

Naugatuck Valley Steamboat Co.

Pier 39 East River, New York.

Quick Time. Low Rates. Careful Handling.

Freight Received DAILY Until 6 o'clock, P. M.

—FOR—

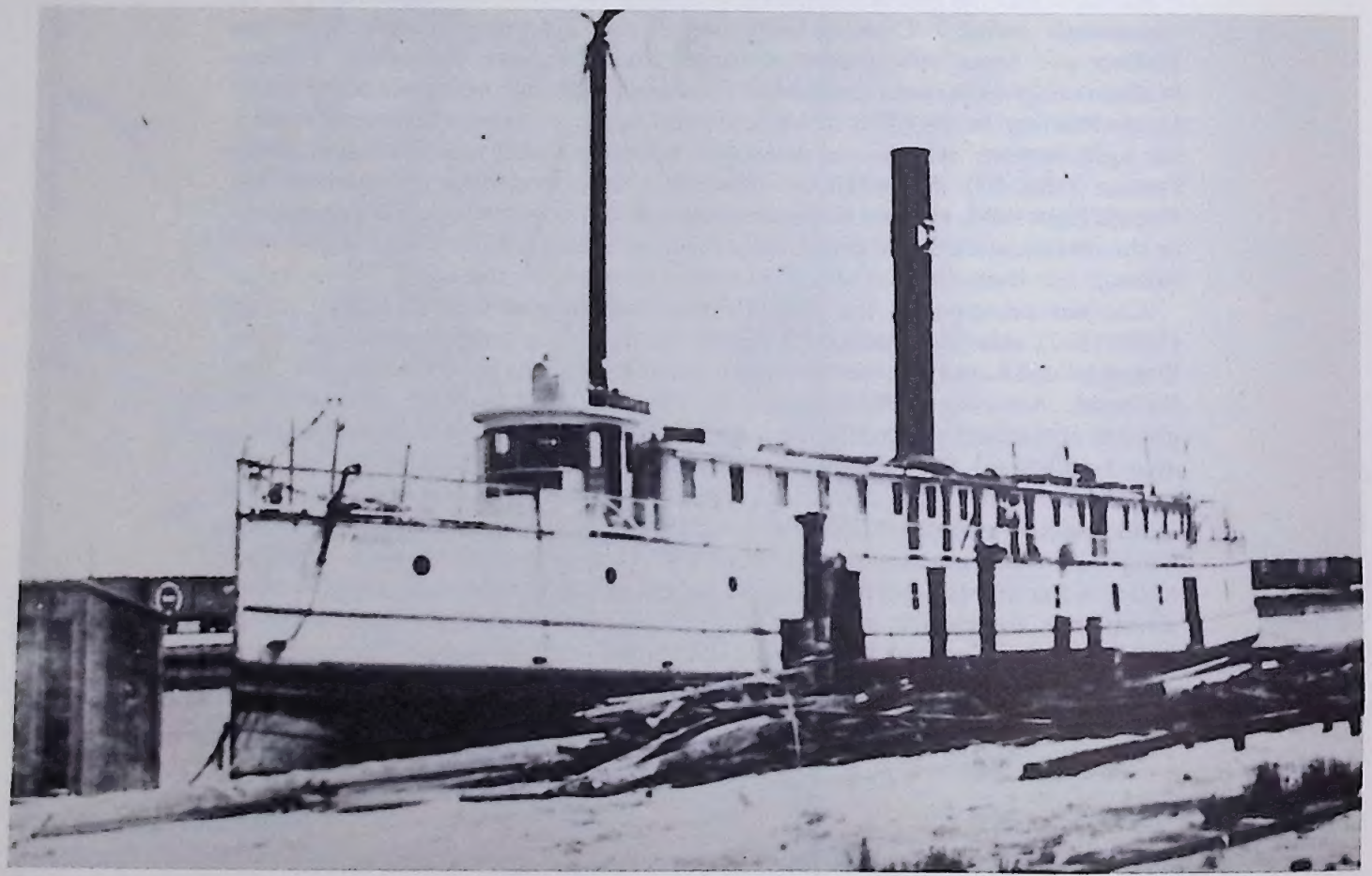
Ansonia, Birmingham, Shelton and Derby, Conn.

P. D. ACKERMAN & BRO., New York Agents.

H. HOLTON WOOD, President.

Office, 239 Main St., BIRMINGHAM, CONN.

Advertisement for the Naugatuck Valley Steamboat Company. From an area directory published in 1888. *(Derby Public Library)*



S.S. *Naugatuck* was built by Pusey & Jones of Wilmington, Del. in 1887. Her iron hull had a reinforced bow for winter navigation on the Housatonic River. Her dimensions were: length 159.9 feet, beam 26 feet, depth 7.2 feet. 449 gross tons. In the 1890s she was lengthened 29 feet and renamed *Tarpon*. She sank in the West Indies in 1937. *(Mariners Museum, Newport News, Va.)*

gatuck, with a reinforced hull to permit her to break through ice on the Housatonic, was supposed to be capable of year-round service, but the supposition proved to be overoptimistic.

In April 1887, the Derby Horse Railway contracted[3] with the Van Depoele Electric Manufacturing Co. of Chicago for electrification of the line. The superintendent of the railway was James D. Kennedy (1854-1935), who came from Scranton, Pennsylvania, where he had been working on a Van Depoele-equipped line. The choice of electric propulsion was a bold move when it is considered that in July 1887 there were only a dozen electric railways in the United States and Canada. Eight of these had been installed by the Van Depoele firm. Charles Van Depoele's operation was based on a kind of missionary zeal—as was the enterprise of all of the electric railway pioneers: Henry, Short, Bentley, Knight, Daft, and Sprague. Lacking enough funding for development, these men accomplished much, under trying circumstances.

William J. Clark may have made the contact with the Van Depoele firm that led to the contract for electrically equipping the line. Van Depoele's Scranton and Montgomery installations were undoubtedly the ones that inspired Clark's confidence in Charles Van Depoele. Indeed, he was highly impressed with the man's genius. Van Depoele was limited by lack of capital and told Clark of his desire to expand his horizons. General Aaron K. Stiles, the general manager (and principal stockholder) of the Van Depoele company, which had been established to manufacture electric light equipment, had little faith in the future of electric railways. Therefore, Clark proposed to the Thomson-Houston Electric Co. that it expand into the electric railway field by purchasing Van Depoele's electric railway patents, which were of basic importance in challenging the competition, particularly Frank Sprague's Electric Railway and Motor Co. (see Background section, p. 1).

General Stiles was happy to unload the electric railway department of his firm on Thomson-Houston (and later the electric light department as well). Charles Van Depoele went into the employ of Thomson-Houston and was at the Lynn, Massachusetts, factory in March 1888. On April 4, it was reported that "The Thomson-Houston Electric Co. of Boston, Mass., having purchased the entire plant of the Van Depoele Co. of Chicago, making it the largest company manufacturing electrical appliances in the world, has engaged the services of ex-postmaster W. J. Clark to look out for its interest in Connecticut and adjoining territory." Shortly after the opening of the electric line, an Electrician Week (what today would be called an Expo) was held in Birmingham[4] to extoll the progress of the Thomson-Houston firm in the electric railway field. As the announcement of the occasion states, "Ever since it purchased the Van Depoele system its motto has been 'Upward and onward.' To date the largest freight motor ever built is that for our local road." It added that the undesirable features of the Van Depoele system were being changed—single-end cars requiring turntables; platform-mounted motors with chain drive were to give way to double-end cars with

Portrait of Charles Joseph Van Depoele, 1846-92.
(Smithsonian Institution)

The Thomson-Houston Electric Railway System.

The Thomson-Houston Electric Company has recently Purchased all the Van Depoele Electric Railway Patents.

SIXTEEN ROADS IN DAILY OPERATION UNDER THE THOMSON-HOUSTON AND VAN DEPOELE PATENTS.

All Material is now manufactured at the FACTORY at LYNN, Mass., the Largest and Best Equipped Electric Factory in the World.

The Thomson-Houston Motors are superior to all others for railway work.

Only one pair of brushes for each motor.

Brushes self-feeding.

Bearings self-oiling.

No change of brushes for change of load or change in direction of rotation of the armature.

The cars run in either direction with equal facility.

The current is controlled, the car reversed, and the brakes applied from either platform.

Motors are placed beneath the car and do not project above the floor.

Direct gearing is used.

The best and neatest overhead system is covered by the Van Depoele patents.

Contact with overhead conductor is had by means of trolley pressing against the wire from below.

MOTORS AND ELECTRICAL EQUIPMENTS FURNISHED FOR MINING AND OTHER SPECIAL WORK.

For full information and estimates address the

THOMSON-HOUSTON ELECTRIC COMPANY,

178 DEVONSHIRE ST., BOSTON, MASS. 148 MICHIGAN AVE., CHICAGO, ILL.

Advertisement for the Thomson-Houston Electric Company in the July 1888 issue of *The Electrical World*, announcing the company's aggressive entry into the electric railway business, armed with the valuable patents of Charles Van Depoele. The chief competition was the Sprague Electric Railway and Motor Company. *(Engineering Societies Library, N.Y.)*

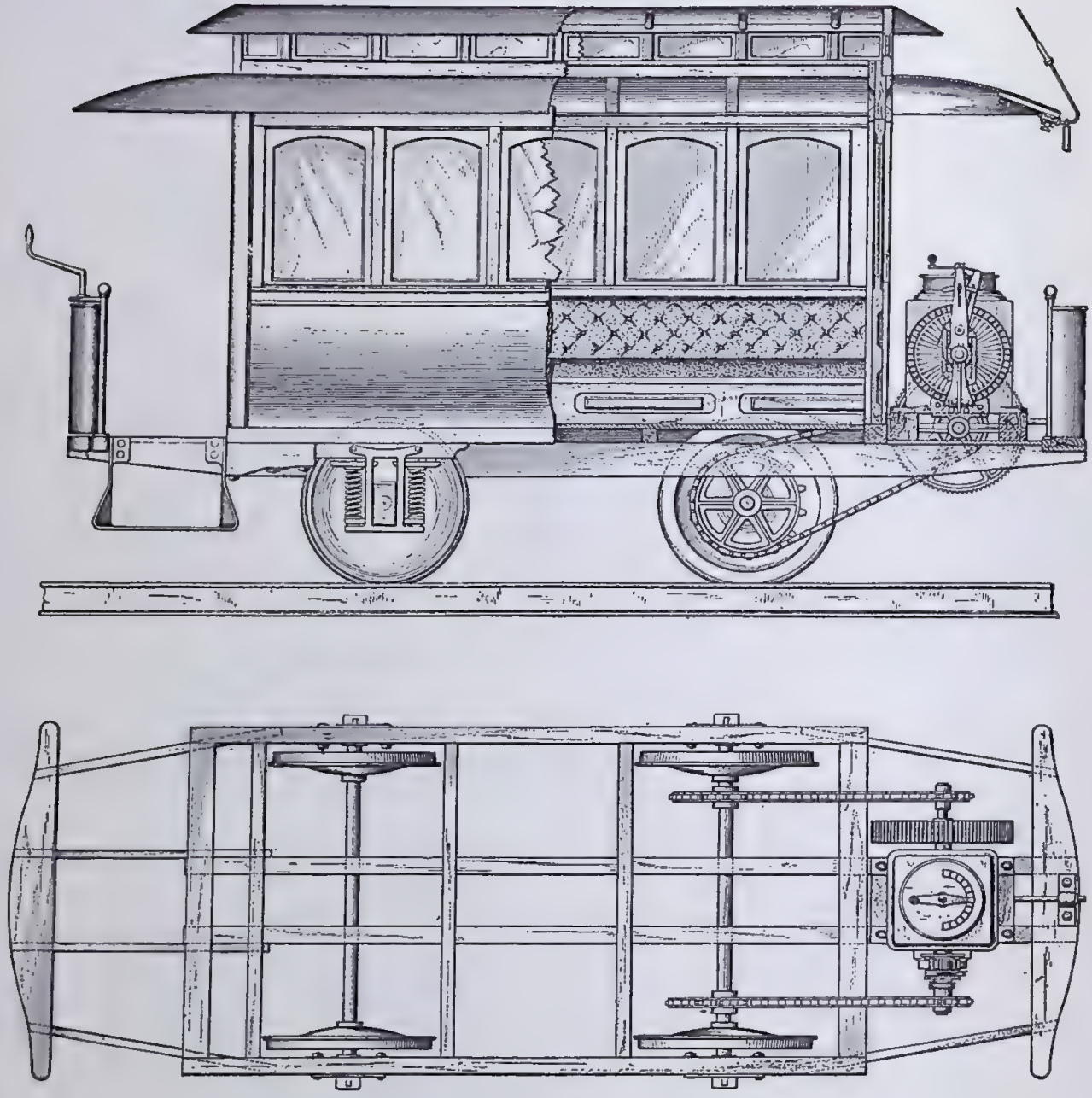
motors mounted in the car truck, and with direct gearing of the motors to the axles. In 1897, Clark, who was then manager of the General Electric Company's railway department, gave Frank Julian Sprague the use of the test track at Schenectady for the development of Sprague's multiple-unit control system, first applied to Chicago elevated cars.

The Birmingham and Ansonia Horse Railroad Co. was being built at the same time as the electric line, on the west side of the river. It overlapped the electric line on Main Street in Ansonia and ran along Main Street in Birmingham, to the railroad station in Old Derby. Where the two lines ran together, the electric line dominated the crown of the roadway, and the horsecar line occupied the side. The horsecar line was completed first, and its cars commenced running during the middle of August 1887.

William J. Clark drove the first spike for the electric railway on May 2, 1887. The line was about four miles long and was substantially constructed, using 52-pound (to the yard) side-bearing Johnson girder rail.[5] Because the passenger cars were single-ended, small turntables were provided to change direction of the cars at the ends of the line and at Derby Junction. Passing sidings were provided at intervals. These had switches without movable points and were made with a guard that directed the car wheels to the right track. The bonding for the negative return circuit, as first done, proved inadequate and there was interference with telephone service along the line. Several attempts were made to improve the return circuit.[6] When the line was shut down in December 1888, a copper ground wire was laid along the whole length of the line and cross-connected to the rails. This seemed to solve the problem.

A single overhead conductor wire of 380 mils diameter[7] was used, fed with 500 volt D.C. power from the generating station at Derby dock. The wire suspension was by span wire between poles and in some places by bracket arms. The cars were equipped with a trolley pole with contact by a grooved bronze wheel. Van Depoele was the inventor of the trolley pole, of which he made the first conventional use on the line at the Toronto Industrial Exhibition in 1885.[8] This line was built in 1884 [9] with a form of conduit current collection.[10] It was operated quite satisfactorily on this system, but in 1885 the change was made to an overhead wire.

Most of Van Depoele's early lines collected power by the use of a grooved-wheel "traveler" that ran on single or double overhead wires. The traveler was invented by Dr. Joseph R. Finney of Pittsburgh and patented in 1880.[11] A form of this was first used on Siemens and Halske's experimental line at Charlottenburg (Berlin) on April 24, 1882.[12] The traveler was connected to its car by a flexible cable. On occasion it came off the wire and was likely to fall on the roof of the car; it was heavy enough to do considerable damage. Replacing it on the wire(s) was accomplished with a long pole. Passing cars had to exchange travelers, as there was no practical way to direct them through overhead switches.[13] Van Depoele was issued a number of patents for various adaptations of the traveler that would



"The Van Depoele Electric Motor, as Applied to Street Railway Cars." From the Electric Railway catalog of the Van Depoele Electric Manufacturing Company, 1887. *(F. S. Bennett Collection)*

permit overhead switching. The large system installed by Van Depoele at Montgomery, Alabama, in 1887 had several lines that branched and crossed. This forced the introduction of a workable overhead switching system. Van Depoele reverted to and improved the current collection which he had introduced in Toronto.[14] His patent for a "Suspended Switch and Traveling Contact for Electric Railways" was applied for on March 12, 1887, but not issued until April 1, 1890.[15] It established Van Depoele's primacy in the invention of this basic device. This was the current collection system used by the Derby Horse Railway. An original overhead "frog" from the line is in the collection of the Shore Line Trolley Museum, at East Haven, Connecticut. It very closely follows the patent drawing.

There was passenger service on the Ansonia end of the incomplete line in September 1887, using horse-drawn trailer car No. 4.[16] Track construction for the electric line was completed in the middle of December. On completion of the whole line, the freight cars were immediately put into use, "and the first cars, loaded with ingots for the Ansonia Brass & Copper Company, were hauled from the Derby dock to Ansonia. For the present, however, horses will be the motive power, but even that will be better than highway teaming."[17]

The power plant was built at the Derby dock, at a place called Point of Rocks, and it was placed high enough above the river bank to avoid flooding during freshets. The boiler, steam engine, and dynamo for it arrived on September 10,[16,18] and building construction commenced soon thereafter. It took a long time to put the plant in operation.[19] The commencement of electric operation was deferred a number of times, until finally the trial operation of an electric car took place at 11 P.M. on April 30, 1888, with Van Depoele's representative, Elmer Morris, as motorman.[20]

The car barn and workshop was located in Ansonia, on the west side of Main Street, near Water Street in a stone building that had been the J. G. Curtiss stables. It was just north of the Ansonia Novelty Company's stone factory.[21] The best photograph of the line's electric locomotive in action was taken on the car barn entrance track, with the Ansonia Novelty Co. building in the background. Coupled behind the locomotive is a flatcar load of Hawkins ice skates that had been made in the factory.[22]

One passenger car, No. 4, had arrived at Ansonia on July 31, 1887.[23] This was a six-window, deck-roofed vehicle that was purchased secondhand from the Fourth Avenue Railroad (New York & Harlaem) in New York[24] and was intended to be used as a trailer. It was wider than the horsecars of the Birmingham and Ansonia line, and the electric cars of the Derby Horse Railway.

The line's three electric passenger cars and five freight cars were built by the J. G. Brill Co. in Philadelphia.[25] The passenger cars were ordered in April 1887 and the freight cars in July. All of this equipment was delivered in the fall on two long flatcars owned by the Brill Co. As noted previously, some of the freight cars were put to use in December. A newspaper account of January 7, 1888, states that "the

Car of the Birmingham and Ansonia Horse Railroad Company. This is the only known photograph of the equipment of this short-lived operation. Its franchise and track were purchased by Col. H. Holton Wood in 1889. (*Old Derby Historical Society*)

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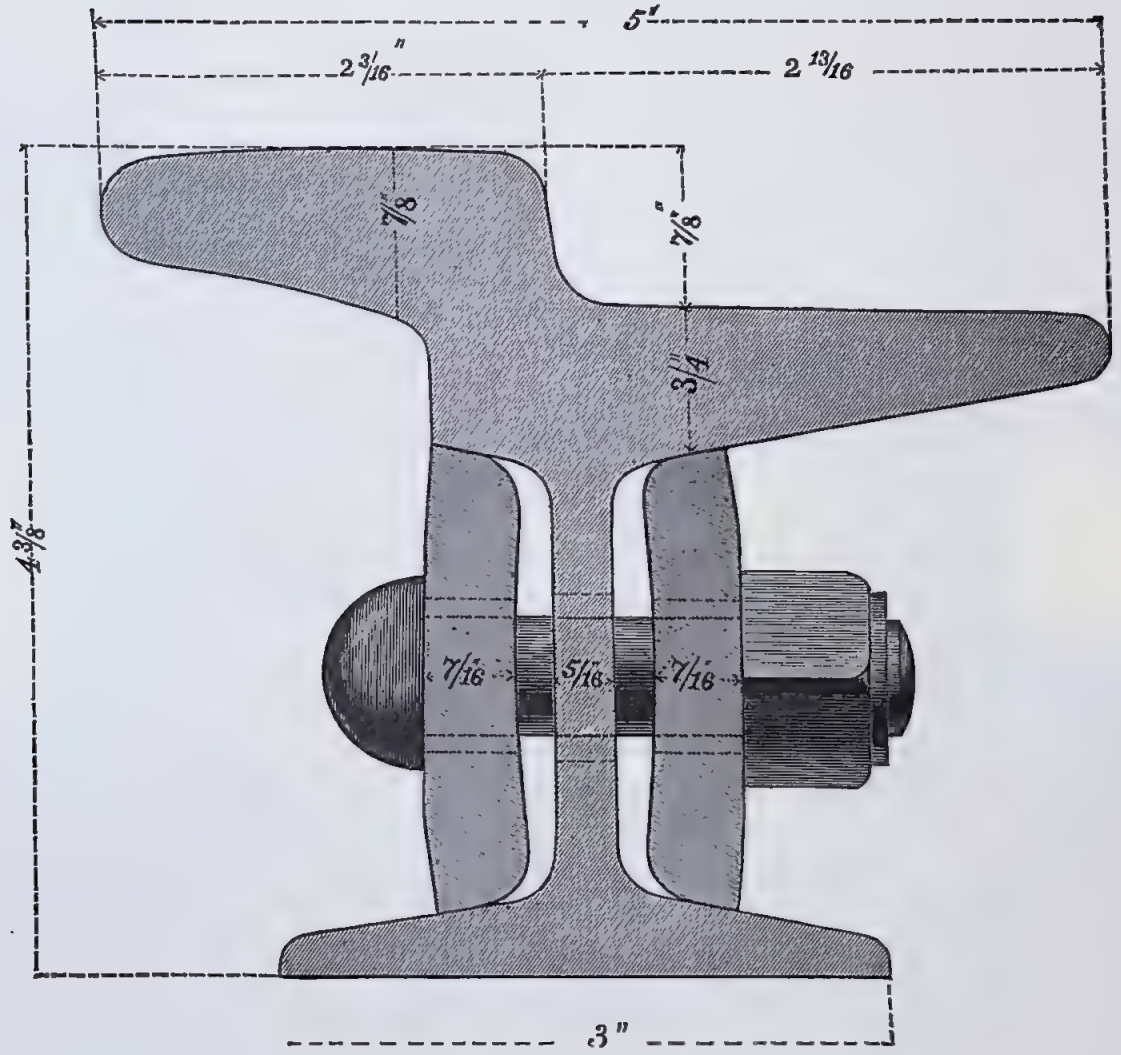
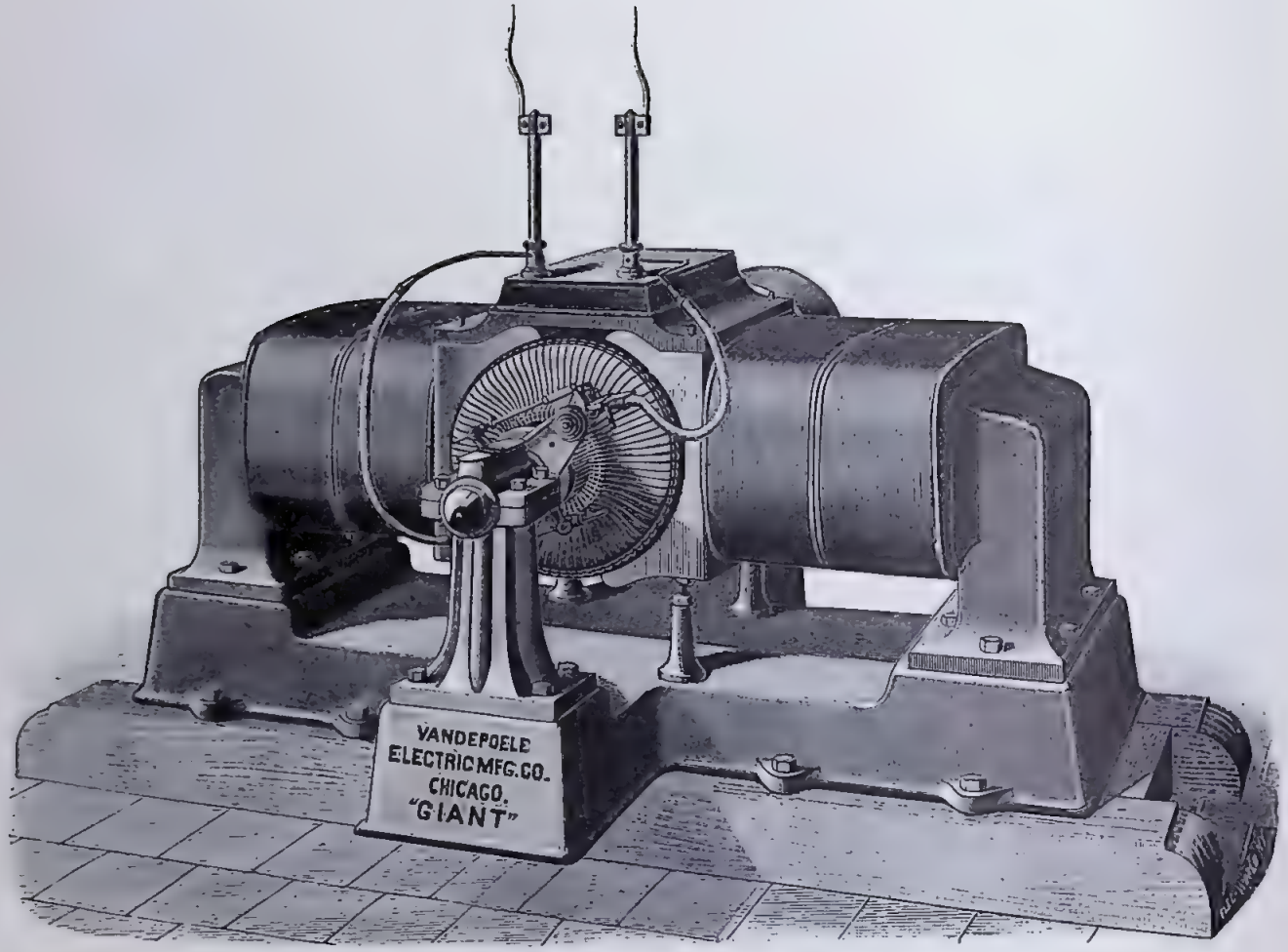


52 to 56 lbs. per yard. $81\frac{15}{22}\frac{9}{40}$ to 88 tons per mile.

Fifty-two pound, side-bearing Johnson girder rail. From an undated manufacturer's catalog, but undoubtedly 1880s. *(J. R. Stevens Collection)*



Van Depoele "Giant" dynamo. From the Electric Railway catalog of the Van Depoele Electric Manufacturing Company, 1887. *(F. S. Bennett Collection)*

The three original single-end passenger motor cars, and a fourth car ordered in 1888, were built by the J. G. Brill Company in Philadelphia. They were delivered without electrical equipment but the axle sprockets for the chain drive were in place. (*Brill Collection, Historical Society of Pennsylvania*)

Arrival of the rolling stock from the J. G. Brill factory—three passenger cars and five freight cars on two long flat cars owned by the builder. (*Hall Collection, B.E.R.A.*)

passenger cars of the electric road, which for several months stood on the tracks near the Derby Depot, are now stored in the yard of the company upon Main street."[26] On March 24, the paper noted "Motors have been placed in some of the elevated (*sic*) cars"[27] and further on April 25, "The passenger cars of the Electrical road are now completed and ready for running."[28]

The electric passenger cars were about twenty feet in length. An internal bulkhead divided the body into a twelve-foot passenger compartment and a four-foot motor cab. The clerestory ended at the bulkhead. The rear platform was of normal construction; the front of the car had hinged double doors. There was a built-in fare box for one-man operation in the bulkhead at the motorman's cab. In the car body were four incandescent lights, and on the rear platform there was a fifth. The long, facing seats were "handsomely upholstered." The trolley pole was carried in a yoke on the end of a standard set at the front edge of the clerestory. The standard was stayed to the roof with iron rods. Three long coil springs were attached at the inboard end of the trolley pole and to the standard at the clerestory roof. The motorman's position was on the right-hand side of the motor. On the cab roof over his head was the gong. There was a lever-operated hand brake. Photographs of the cars show two sets of brake shoes. One set has the shoes lever-connected in a toggle arrangement and working between the wheels. Additionally, there were larger shoes that acted on the outside of the rear wheels only. There was no hand brake on the rear platform. The builder's photograph (page 17) shows the handle of a second lever behind the taller one that was evidently the service brake, but the function of this is in doubt. The account of a car's operation given in the *Hartford Daily Times* implies that there was some form of electric braking operated by the controller handle on top of the controller. Van Depoele had been issued a patent for a solenoid-activated electric brake that worked on the inside of the wheels in an arrangement like that shown in the builder's photograph.[29] The streetcar motors were rated at fifteen horse-power, and the cars were to carry forty passengers at twelve miles an hour. They were said to reach twelve miles an hour "on level places."[30] Sometimes they were overloaded with as many as seventy-five people on board.[31]

The cars were painted "Broadway colors"[32]—cadmium yellow and orange. Samples of these colors were uncovered on the line's locomotive during its restoration in 1983. A newspaper account (in the *New Haven Daily Palladium*, May 1, 1888) of the trial run on April 30 describes the car, No. 2, as a "handsome cream colored four wheel car." The cars had ANSONIA, DERBY & BIRMINGHAM lettered on their letterboards, and ELECTRICAL LINE on the lower body panels.

The opening of the line for electric operation was fully recorded in newspapers of the time[33] (see appendices), and a Hartford paper described the operation of the electric cars in great detail.[34] It had cost $75,000 to build and equip the line.

As often happened when road vehicles were introduced without the real "horse power," the electric cars had their effect on the local horses. "The horses about town do not take kindly to the cars and there were some narrow escapes

Main Street in Birmingham (now Derby) looking west. The farther of the two electric cars is on the turntable at the end of the track. The track of the Birmingham and Ansonia Horse Railroad occupied the south side of the roadway at this location. Some of the buildings shown still exist. One of a series of photographs taken in early May, 1888. (*Hall Collection, B.E.R.A.*)

In this view looking east, cars 1 and 3 are shown at Derby Junction, opposite the Main Street bridge to Birmingham. The man in the dark suit standing between the cars is James D. Kennedy, the superintendent of the Derby Horse Railway. A switchback and turntable south of the embankment put the cars on the lower level and gave access to the bridge. The houses in the background of this picture were demolished to make room for the Shrine of Our Lady of the Immaculate Conception. One of a series of photographs taken in early May, 1888. (*Hall Collection, B.E.R.A.*)

On Derby Avenue. The overhead construction with bracket arm suspension is well shown. One of a series of photographs taken in early May, 1888. (*Hall Collection, B.E.R.A.*)

A passing siding on Derby Avenue. The switches do not have movable points; a rail guard directed the cars' wheels on the right side of the siding. The overhead conductor wire is supported by span wires—the more common method used on the line. Note the "frog" in the overhead. A surviving specimen is illustrated elsewhere. One of a series of photographs taken in early May, 1888. (*Hall Collection, B.E.R.A.*)

from accident yesterday. In a few days, however, they will become accustomed to them; at least they do in other towns."[35]

The trials and tribulations of the cars are told in the newspapers. Early in May, car No. 3 had a pedestal broken by a falling stone while passing through the Derby cut.[36] Several times in June cars had their supporting arms and travelers wrenched off because of dewirements.[37] Also in June, motorman Charles Doran was badly injured when the brake chain broke, and he was thrown against the revolving armature.[38] In July, the armatures of a passenger car and the locomotive were burned out when they were struck by lightning.[39] Mishaps recorded during the last months of the year include a number of burned out armatures, a broken axle, and a broken sprocket.[40]

There had been a number of minor stoppages of the power plant, but on the night of November 30 the flywheel burst and put the plant out of operation for a month.[41] A limited passenger service was maintained with cars, crew, and horses borrowed from the Birmingham & Ansonia Horse Railroad. Freight also continued to be handled, hauled by horses.[42] The last trip of the season by the *Naugatuck* was reported on December 19; thereupon freight haulage on the electric line ceased until the reopening of navigation in 1889. In December Baker heaters were installed in the cars,[43] placed against the front bulkhead.

On the night of April 10, 1889, the electric line suffered its first fatality. Jeremiah Lyons, age seventy, was walking along the track in a drunken state in Derby, at a passing siding. As a car was passing him, he stumbled against it and fell back against an earth bank. He then fell under the wheels of the car, which passed over his right leg. He died from shock and loss of blood. The motorman, Patrick Tully, claimed he had been coasting with the power off at the time of the accident.[44]

J. G. Brill recorded an order on June 21, 1888, for another car for the line of the same type as the first three. This left the Brill plant on September 1 and was placed in service in November, as No. 5.[45]

In November 1888, trailer No. 4 was broqght into the shop to be rebuilt into a double-end motor car under the supervision of foreman George Kennedy. It had been bought for use as a trailer but proved too heavy to be hauled by the Brill motor cars. Its only use had been to be hauled on occasion by the locomotive.[46] It was equipped with a Thomson-Houston truck and motors. Trials were carried out in February 1889,[47] and in April it was given an improved design trolley base and wooden pole.[48] Also in April, lightning arrestors were installed on the cars.[49]

Operation of No. 4 proved to be far more satisfactory than the single-ended, single-motor cars. It was more powerful, with each axle powered by a direct geared, double reduction motor. Further, these motors were equipped with carbon brushes (invented by Charles Van Depoele) instead of the copper brushes of the other cars. Because of its demonstrably improved performance, it was decided to rebuild the other cars to the same standard. Cars 2 and 5 were

Car No. 4 was a second-hand horsecar from New York. In 1888 it was rebuilt to a two-motor, double-ended electric car using Thomson-Houston equipment. This photograph, taken in front of the new car barn in the early 1890s, also shows the second No. 1, which also has Thomson-Houston equipment. *(Hall Collection, B.E.R.A.)*

The body of car No. 4 is shown in the barn, stored on horses, in a photograph taken in 1895. Behind it are the bodies of the 1887-88 motor cars. The trucks and motors from these bodies are in use under the open cars shown on the left. (*F. S. Bennett Collection*)

therefore sent to Boston to be rebuilt. They arrived back in November, but not as complete cars. The bodies were returned first, and it is not recorded who had done the work on them. The trucks and motors came from the Thomson-Houston factory in Lynn. It was reported that "work will be carried on day and night to put them together."[50]

No. 5 was out on the line for a trial run on November 22. It ran faster than No. 4, which had been the fastest car up to that time. "Eighteen miles has been attained an hour by the new cars. The exteriors are painted a dark orange color. The interior is handsomely painted and finished off. Three incandescent lights are suspended from the center and one is placed at each end. A small stove placed on one side as in city horse cars will heat it. The trolly (*sic*) is a new patent and is a great improvement on the old one. The bell is worked by a foot lever conveniently adjusted for the motor man. . . . Cars No. 1 and 3 are to be sent away and supplied with the new motor system."[51]

There is something of a contradiction here, as in the report just quoted, cars 1 and 3 are to be sent away, whereas the J. G. Brill Co. records show the order for the alteration of the two cars entered on August 30. They were to be ready for shipment back to Ansonia on December 1, "sure."[52] In late February 1890, it was reported that "Car No. 1, of the Electric road, has been to Philadelphia undergoing repairs and improvements such as the other cars of the Electric road have had. It is on the siding at the junction. It will be taken from there and adjusted for the road as soon as possible."[53]

A photograph of car No. 6 (ex No.?) as rebuilt exists. Changes to it involved the replacement of the former front end with a bulkhead and platform of the same design as the original back platform. The internal bulkhead was removed, and the clerestory extended the full length of the body. The narrower side windows at the former cab-end were retained.

Thus, by the beginning of 1890 all of the Van Depoele streetcar equipment had been replaced by technologically superior equipment produced by the Thomson-Houston Co. The double-end cars made it possible to discard the turntables. Only the electric locomotive survived as an example of primitive electric railway technology.

The Birmingham and Ansonia Horse Railroad line did not pay its costs and was placed in receivership in the middle of 1888.[54] While the electric line's power plant was shut down through most of December, the receiver of the horsecar line put some of his cars to use on the electric line's track between Birmingham and Ansonia.[55] In the summer of 1889, horsecar service ceased. In September, Col. H. Holton Wood bought the franchise and track of the horsecar company.[56] While he reportedly gave some consideration to the electrification of the line to form a "belt line" this was not to happen and the trackage was taken up. The belt line service finally came into being in 1894.

In November 1889, the electric line was extended west along Main Street in Birmingham, to Elizabeth Street and north on it to the Public Square, ending at

The four original single-end motor cars, Nos. 1, 2, 3, 5 were rebuilt to double-end configuration. This is one of them, renumbered, following an accident at Lake Housatonic Park. The branch line to the park opened in 1895. The two narrower windows indicate the location of the original motor compartment. (*Hall Collection, B.E.R.A.*)

the new Sterling Opera House.[57] In February 1890, two of the horsecars which had been purchased by the electric line were taken to the shop at Ansonia to be converted into trailers for the electric cars.[58]

An editorial in the December 18 issue of the *Derby Transcript* gives a good picture of the traffic volume carried by the streetcars. The last month of their running, the horsecars had carried an average of 540 people a day. At the same time, the electric cars carried an average of 758. The month following the cessation of horsecar service, the electric line's daily average went up to 912, and the following month was 924.

When the freight operation was given up in October 1889, so too was passenger service along Front Street in Old Derby. Residents of the area tried to get the company to reinstate this service, but it refused, claiming that only a small number of people had used the service. The track was left in place.[59] In December, the river overflowed its banks and "The electric road's plant in lower Derby was surrounded by water, and a raft was used by the men there to go and come from their building. The freight cars belonging to the Electric road, were on the dock with only their tops visible above the water."[60] In February of 1890, the Derby selectmen ordered the electric line to bury the disused track from Derby Junction to the dock. At a public meeting lower Derby residents again attempted to convince the company to run streetcars down Front Street,[61] but again the company refused, and the track was taken up. Some of the freight cars may have been disposed of at this time, but the box car was kept and later went on display, with the locomotive at Pine Rock Grove.

With the track connection gone, the power plant was isolated from the electric line. In the 1890s a new car barn and power plant were built in Derby near Factory Street. The Van Depoele dynamo was replaced by up-to-date Edison machines. The line's original passenger cars, in their altered form, were kept in use for a number of years. An 1895 photograph shows the bodies stored on horses in the car house, the trucks being in use under open cars.

Connecticut's second and third electric railways were opened soon after the Derby Horse Railway. The Meriden Horse Railroad was equipped on the system of Leo Daft, which was applied to the company's horsecars. Electric service was inaugurated on July 16, 1888. Double overhead wires were used, on top of which ran a traveler connected to the motor car with flexible cables. Great trouble was experienced with this installation, and after two and a half years electricity was abandoned, the cars reverting to horse power.

The Wethersfield branch of the Hartford and Wethersfield Horse Railway Co. was electrified by the Sprague Electric Railway and Motor Co., and electric car service commenced on September 22, 1888. Several horse cars were electrified with equipment that was the same as that used on Sprague's installation at Richmond, Virginia. A reversible, spring base trolley pole was used for current collection. The three-mile electric operation was beset by many difficulties, most of which were accountable to the primitive state of the art at the time. But the electric cars kept running until the rest of the system was electrified in 1892.

The Meriden Electric Railroad was Connecticut's second electric streetcar line. It was equipped by the Daft Electric Light Company. It opened on July 16, 1888. The operation was not a success and the cars were converted back to horsecars. (*Hall Collection, B.E.R.A.)*

The Hartford & Wethersfield Horse Railway Company's Wethersfield branch was electrified on September 12, 1888, as Connecticut's third electric streetcar line. The work was carried out by the Sprague Electric Railway and Motor Company. While this electrification functioned reasonably well, the rest of the Hartford system was not changed over until 1892. (*Hall Collection, B.E.R.A.)*

The World's First Electric Freight Locomotive

In April 1888, a yellow, four-wheeled railway car the size of a horsecar arrived on a flat car at Old Derby. Lettered ANSONIA, DERBY and BIRMINGHAM—ELECTRICAL LINE MOTOR, the car was soon placed on the track near the Naugatuck railroad station, where it was an object of curiosity to local residents and others who had read about its arrival in local newspapers.[62] Much of the interior of the low-roofed vehicle was occupied by a very large, bi-polar electric motor that was rated at seventy-five horsepower.

This was the world's first electric locomotive to be built—and successfully used—for the commercial haulage of freight. And it was a wholly American product! The railway car was built by the Pullman Palace Car Co., of Pullman, Illinois, and the motor was manufactured by the Van Depoele Electric Manufacturing Co., of Chicago.

On May 1, the locomotive was towed over the line by four horses to the car shop at Ansonia to be fitted out for operation under the direction of Elmer Morris, Charles Van Depoele's trusted lieutenant.[63] Morris had been in the area since the "Blizzard of '88" to supervise finishing touches of the electrification. He had come from a job in Jamaica, New York, and was due to go on to another at Dayton, Ohio. On May 13, the locomotive was taken out on the line for a trial, pulling passenger trailer No. 4.[64] It ran well enough, but derailed on the switch leading into the car shop and blocked the horsecar track. The next day it was out again, this time with four freight cars in addition to the trailer. On this trip, it came off the track three times.[65] Since something was obviously wrong, it went back into the shop for alterations. Just what corrective measures were taken are not recorded, but it is possible that the wheel base was reduced. At present it is 5 feet, 4 inches.

A story in later years reported that the locomotive had been built too high for the low-clearance railroad trestle that it had to pass under to get to the Derby Dock. It had thus been necessary to cut the height of the car body down by two feet to correct this design error![66] In contemporary accounts there is no confirmation of this, only references to the derailment problems. Old photographs of the locomotive show cuts in the car's siding, just above horizontal pieces of a makeshift nature, that covered the lower part of the siding. Important evidence was lost when the car's sills were replaced in 1929. At the time the car was repaired at the Shoreline Trolley Museum in 1983, no evidence was found in the framing to indicate that a major rebuilding had taken place, such as lowering the roof.

It seems more likely that the locomotive was, like the line's box car, designed low to fit under the trestle. The A frame that supported the trolley pole was hinged, so it could be lowered on the roof to cope with the low clearance problem. Between the heavy longitudinal sills that supported the motor, and on

The Derby Horse Railway's ELECTRICAL LINE MOTOR is shown with a loaded flatcar in Ansonia soon after entering service in July 1888. On the adjacent track, passenger motor car No. 1 is sitting on a turntable. In the top left of the photograph is an overhead "frog" like the one preserved by the Shore Line Trolley Museum. *(F. S. Bennett Collection)*

The electric locomotive in service in 1889, showing signs of heavy use. Hawkins's skates were manufactured in the building in the background and are part of the cargo on the two flat cars. The young man on the step of the MOTOR is George Fosdick, its regular motorman. Fosdick died in 1962. (*Hall Collection, B.E.R.A.*)

The electric locomotive in storage in 1895. It had been retained following the abandonment of the freight operation, to use for pushing the line's snowplow. Note the roof-mounted gong, which does not show in the earlier photographs. *(F. S. Bennett Collection)*

each side of the motor, was a well in which the motorman stood. Head room in these wells is 5 feet, 6 inches. The motorman had access to the brush gear, a control switch of some kind, and at each end of the car, a hand-brake lever. Like the passenger cars, the locomotive had double-reduction gearing. Double sprockets on the counter shaft were chain-connected to sprockets keyed to each axle. One set of these sprockets is in good alignment; the other is not because the wheel hub prevented the proper placement of the sprocket. There must have been excessive wear to one of the chains because of this.

Early in June, corrective work on the locomotive was completed and it successfully passed its trials.[67] However, it did not go into service until July 2 because the electric line was shut down by sewer construction in Ansonia. Some new problems cropped up, and Elmer Morris was called back to deal with them. The locomotive ran much better after the chain sprockets were replaced with ones of a better design.[68] At the end of July, it was put out of service when lightning burned out its armature. The same fate befell one of the passenger cars. Lightning plagued the line until arrestors were installed in 1889.

The locomotive performed its duty of drawing freight cars between Ansonia and the Derby Dock until the close of navigation on the Housatonic in December 1888. In November, George Fosdick was appointed the locomotive's regular motorman and retained this position as long as it was in use.[69] Fosdick was nineteen yaars old at the time and lived until 1962.

The locomotive went back into service at the reopening of navigation in 1889 and faithfully moved its loads of copper products and Hawkins skates from Ansonia to the Derby Dock—with incoming goods being carried in the reverse direction. The only recorded incident occurred in June when the locomotive was at the Derby Dock waiting to have cars coupled to it. The locomotive had to be cut off short of the unloading point and the freight cars hand-pushed up a slight grade the rest of the distance. The cars were returned by gravity. George Fosdick was standing at the end of the locomotive, ready to couple a car to it, when a heavily loaded car got away from its attendants and crushed Fosdick's leg between it and the end of the locomotive. Fortunately the injury was not serious, and Fosdick soon was back on the job.[70]

In September 1889, Col. Wood terminated the Naugatuck Valley Steamboat Co. Freight rates had been too low and cargo volume too small to cover the costs of operation. In addition, the steam railroads serving the area had matched the lowered freight rates of the electric line-steamship combination and retained much of their freight business. The consequence was that the electric freight service was given up too. The locomotive remained in use until the middle of October, moving an accumulation of freight from Derby Dock. Believed to be useful in pushing the line's snowplow, it was spared the fate of being scrapped.[71] Whether or not the locomotive actually served this purpose has not been discovered.

The electric locomotive was now in retirement. A photograph taken in 1895 shows it in reasonably good condition, stored in a shed with a road sweeper next to it together with old ties and discarded material. The A frame and trolley pole are laid on the roof, and the trolley wheel is missing from the harp of the pole. Obviously the management of the Connecticut Railway & Lighting Co. (which had taken over the Derby Street Railway in 1900), was aware of the machine's historic importance, for it was placed on exhibit in a company park at Pine Rock Grove. This park was served by the trolley line between Shelton and Bridgeport. Its location was north of the present United Technologies' Sikorsky plant, on the west side of the Housatonic River. The box car was displayed with the locomotive.

Photographs taken of the locomotive from time to time document its progressive decline. Someone photographed the Van Depoele bi-polar motor when it was complete. The maker's plate is plainly visible, and it was identical to one on a Van Depoele streetcar motor that is preserved at the Ford Museum. In 1909, Charles Rufus Harte, chief engineer of the Connecticut Co. (a streetcar operating subsidiary, like the C. R. & L., of the New York, New Haven & Hartford Railroad), took several photographs of the locomotive in its then vandalized state. The few surviving window sashes are without glass, and the doors are disarrayed. One end beam had rotted and fallen off. The field windings are plainly missing. Harte was interested in the work of electric railway pioneers and knew that this Van Depoele locomotive was a unique survivor from the formative years of the industry. It was clear that if it remained where it was, it would be destroyed, so Harte commenced an ultimately successful effort to see it properly preserved. In 1914 it was taken to the Connecticut Co. shop in Hartford, where repairs were carried out. Measured drawings were also produced, from which two large-scale models were built. Harte wrote a paper on the electrification of the Derby Horse Railway with particular reference to the locomotive. The paper, along with one of the models, was presented to the Franklin Institute in Philadelphia.

In its July 1915 issue the journal of the American Electric Railway Association (AERA) featured a story about the locomotive entitled "First Electric Freight Motor—Grand Daddy of the Modern Locomotive Still Preserved By the Connecticut Company." To quote from the beginning of the article, "For many years—until L. S. Storrs, the President of the Connecticut Company, acting as a Good Samaritan, gave it shelter,—there rotted and rusted on a grass grown side track in one of that Company's parks, a crude, unsightly, motor car, that is the grand daddy of all the electric freight locomotives of today." Although some of the information in the article is inaccurate, it did record the locomotive's historic importance. Although Harte is not referred to, two of his photographs illustrate the article.

The locomotive went back into obscurity until 1929, when officials of the New Haven Railroad hit upon the idea of organizing a display of historic railroad equipment.[72] Such an exhibit could be set up on a gallery in Grand Central

At an unknown date, the Connecticut Railway & Lighting Company placed the locomotive on a spur track at Pine Rock Grove, a company park, as a historical relic. Already showing evidence of vandalism. it is being inspected by trolley company personnel. The man on the right is James Kennedy, superintendent of the Derby Horse Railway in 1887 and 1888. He later became roadmaster of the Derby Division of the Connecticut Company. (*Hall Collection, B.E.R.A.*)

On July 21, 1909, Charles Rufus Harte, chief engineer of the Connecticut Company, photographed the locomotive and box car at Pine Rock Grove. All the glass is gone from the locomotive, and the copper windings of the field coils and armature have been removed. (*Harte Collection, B.E.R.A.*)

Station, New York, where it was sure to be seen by the millions of travelers who used the facility. Remembering the early electric locomotive, the organizers borrowed it from the Connecticut Co. and removed it from the East Hartford car barn to the railroad's repair shop in New Haven. Company officials hoped that $500 would be sufficient to put it in presentable condition. A survey of the locomotive found that the side sills were broken and the roof had collapsed. More money was found for the job, the car body was repaired, and new sills were installed. Much of the original siding, which had to be removed to get at the sills, was put back on again, but with the pieces scrambled. Very little new wood had to be used in the repair. The names of the workmen and shop officials involved in the job were written on a piece of paper that was placed on the roof before new canvas was put on; it is dated June 20, 1929. Some thought was given to restoring the motor to operating condition, but this was not done. The missing commutator brush gear was reconstructed and dummy windings placed on the field poles and armature. No effort was made to replace missing doors and windows.

After the locomotive was restored, it was decided that it was too heavy to be placed on the Grand Central gallery. At this time a request was received from the Henry Ford Museum, then recently established at Dearborn, Michigan, for the donation of the locomotive. The New Haven was willing to loan the machine but did not wish to give it away. As this was unacceptable to the Ford people, the idea was dropped. Similar overtures from the Museum of Science and Industry in Chicago were negatively received also.

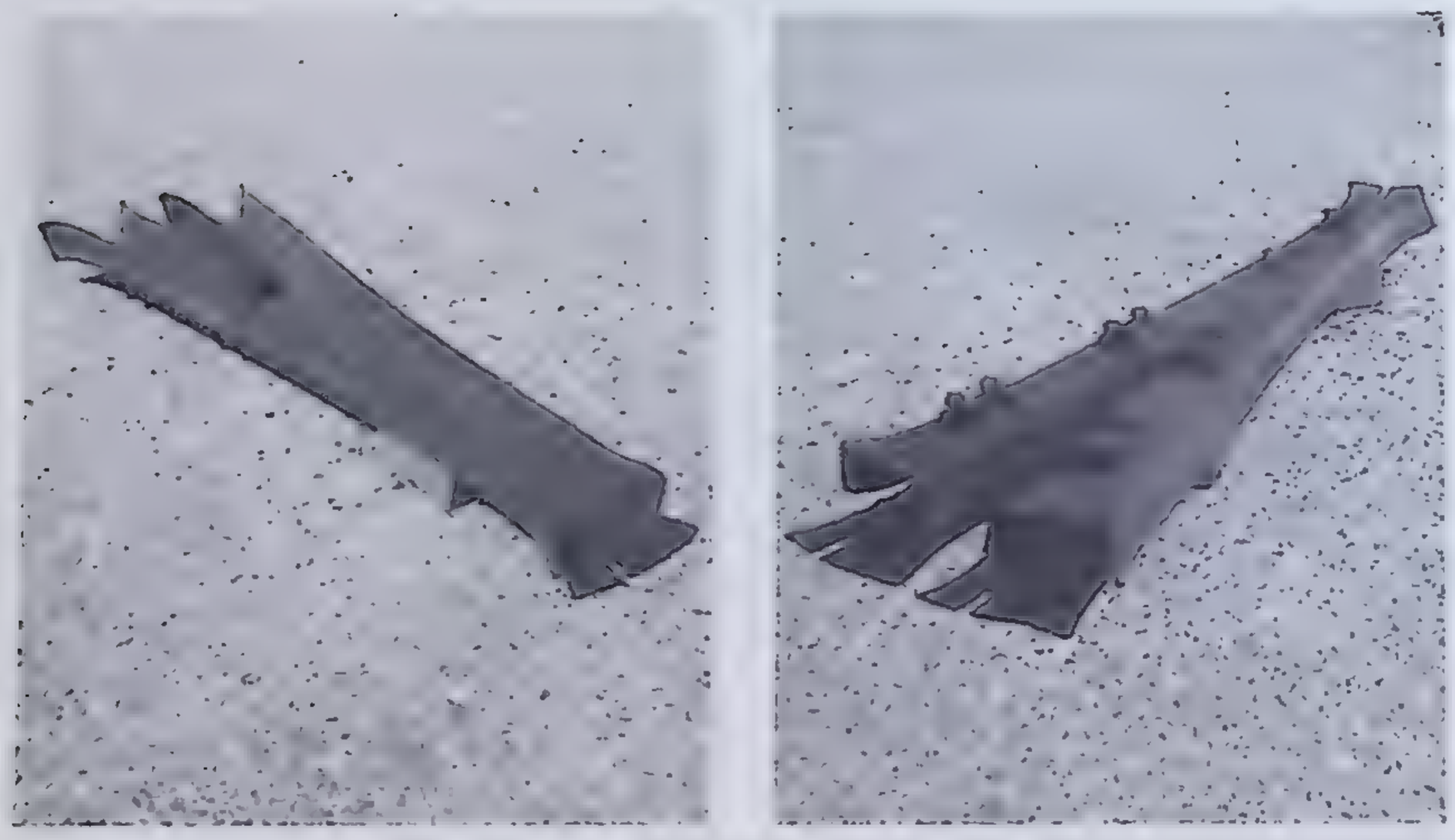
Over the succeeding years, the electric locomotive—sometimes with other units of New Haven's historical collection (the early Boston & Providence passenger car, and inside-connected steam locomotive *Daniel Nason*)—were displayed at points around the system. They were at the New York World's Fair in 1939. The idea of a permanent museum had fallen by the wayside, and caring for the relics was something of a nuisance. In 1950, an offer was made by John W. Leahy to purchase the three pieces of equipment for exhibit at the Danbury Fair. The railroad agreed to let them go for $1,325. The electric locomotive then was valued at $250.

The historic railroad exhibits had a thirty-year stay at the Danbury fairground, where they could be seen for a week in the fall each year, when the Great Danbury Fair was open. Their setting left much to be desired, but nonetheless they survived with some measure of protection. After Leahy's death, the fairground was sold for development. On April 2, 1982, I purchased the Van Depoele locomotive at the Danbury Fair auction and donated it to the Branford Electric Railway Association. The steam locomotive and passenger car were purchased by the National Museum of Transport in St. Louis, Missouri, which very nearly acquired the electric locomotive as well.

Since its arrival at the Shore Line Trolley Museum, the locomotive has undergone a thorough overhaul, and several structural problems have been corrected. New side platform knees have been installed, and the axle box pedestals, which

were badly splayed, have been returned to a perpendicular position. Samples of the original colors were uncovered and matched, and the car body has been repainted in a close approximation of the original livery.

An electrical engineer specializing in motor design, Alfred Marcus of the Safety Electric Company in Wallingford, Connecticut, has designed new windings for the Van Depoele motor. The Committee for the Restoration of Historic Assets in Connecticut (an agency of the Connecticut Department of Economic Development) has given the Shore Line Trolley Museum $10,000 toward rebuilding the motor to operating condition. When this work is completed, the locomotive will once again be self-propelled and capable of pulling a passenger trailer. The objective is to have the machine back in service by July 1988—the centennial of its first commercial use and ninety-nine years after the last time it ran electrically.



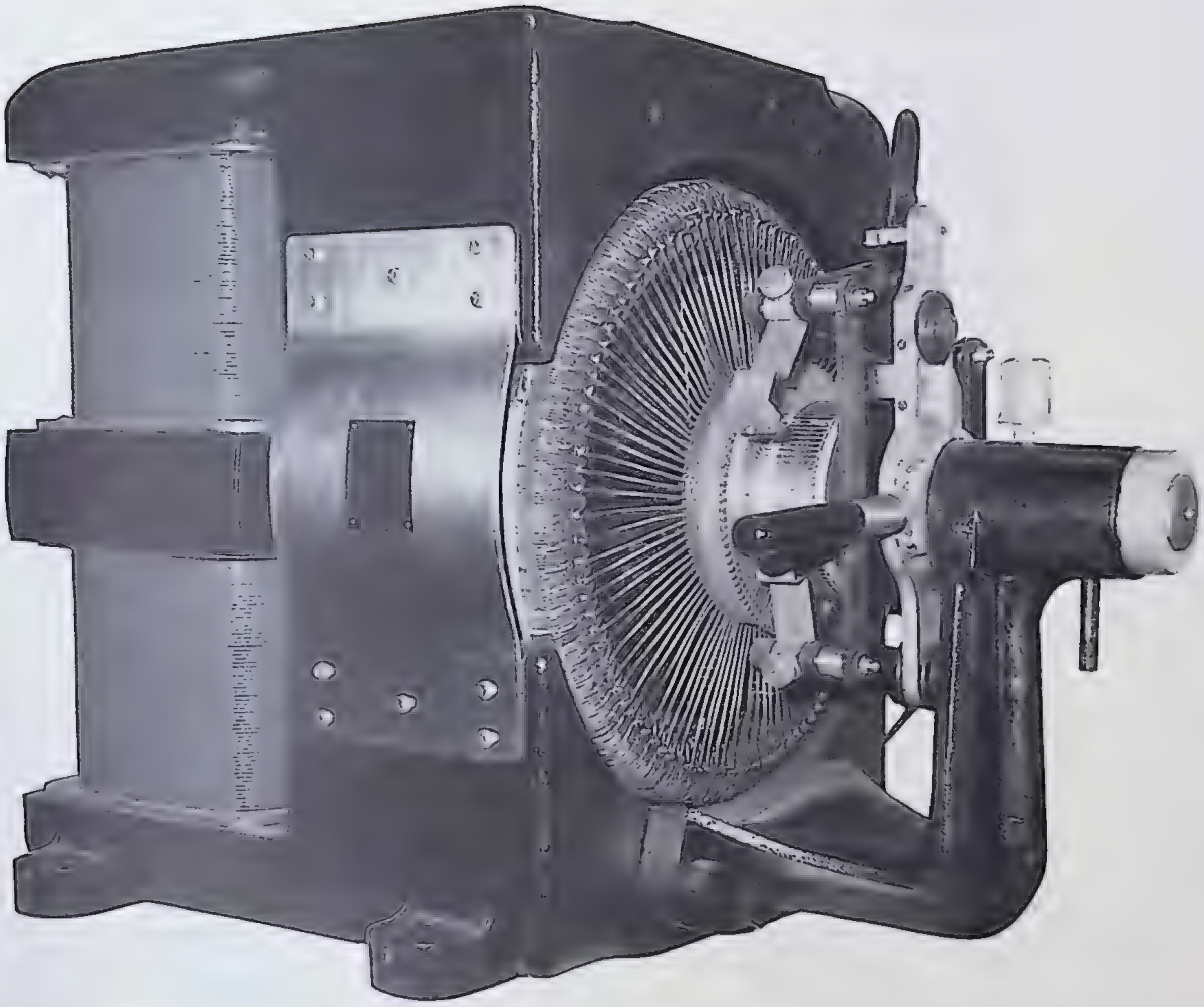
A bronze overhead wire "frog" supplied by the Van Depoele Company to the Derby Horse Railway. Van Depoele is credited with inventing the under-running trolley wheel for current collection. First used at the Toronto Industrial Exhibition in 1885, it was given large-scale use at Montgomery, Alabama, in 1887. *(Collection of the Shore Line Trolley Museum. Photographs by J.R. Stevens)*

Following its partial restoration in the shop of the New York, New Haven & Hartford Railroad in 1929, the locomotive was posed for its official portrait behind the New Haven station. The motor brush gear, which was reconstructed by the railroad, had not been installed at this time. (*Dave Peters Collection*)

The electric locomotive was a traveling promotion for the New Haven Railroad. It was billed as the "First Electric Locomotive built for handling freight, operated in 1888 over the first Electric Railway in New England which is now part of the New Haven System." It is shown at Mount Vernon in the 1930s, with an up-to-date New Haven electric locomotive. It was displayed at the New York World's Fair in 1939. (*Photograph by Al Gilcher)*

The locomotive at the Great Danbury Fair on October 6, 1951, the first year that it was displayed there. The fair closed after the 1981 event, and the locomotive was purchased for the Shore Line Trolley Museum at the fair auction in April 1982. (*Photograph by George E. Votava)*

The locomotive following its restoration to original appearance in the workshop of the Shore Line Trolley Museum. Photograph taken on October 4, 1983. Subsequently, the Boston pivotal trolley base shown has been replaced with a replication of the orginal arrangement. *(Photograph by J. R. Stevens)*



The 75 H.P. Van Depoele traction motor was rebuilt to operating condition, 1986-88 by the Schulz Electric Co. of New Haven with the aid of a $10,000 grant from the State of Connecticut. The brush gear had been reconstructed by the New Haven Railroad in 1929 on the basis of the Van Depoele patent drawing. The new brushes have carbon tips. *(Photograph by Charles B. Gunn)*

Notes

1. The Borough of Birmingham became the Town of Derby in 1893.
2. Thomas Commerford Martin and Stephen Leidy Coles, eds., *The Story of Electricity*, vol. 1 (New York, 1919), pp. 161-63.
3. Charles Rufus Harte, *The Van Depoele Electrification of the Derby Horse Railway Company—1888—Connecticut's First Electric Railway*, undated ms. in Engineering Societies Library, New York (hereafter cited as *C.R.H.*). See Appendix 1.
4. *The Derby Transcript*, May 16, 1888 (hereafter cited as *D.T.*).
5. *The Street Railway Journal* 4 (1888): 75 (hereafter cited as *S.R.J.*).
6. *D.T.*: June 13, 1888; January 2, 1889; *The New Haven Daily Palladium*, June 19, 1888 (hereafter cited as *N.H.D.P.*).
7. *Telegraphic Journal and Electrical Review* 23 (July 6, 1888): 6.
8. *The Van Depoele System of Electric Railways* (Chicago, 1887), pp. 7, 8 (hereafter cited as *V.D.*)
9. In 1883, the Industrial Exhibition Association of Toronto attempted to purchase the electric railway that had been demonstrated at the Exhibition of Railway Appliances, held in Chicago in June. The Electric Railway Co. of the United States was prepared to sell their railway for $10,000. This was too much for the Toronto men, and instead they improvised their own equipment, which ran—but not too well!
10. U.S. Patent 285,858, October 2, 1883, Electric Railway.
11. U.S. Patent 231,552, August 24, 1880, Railroad-Car Telegraph. U.S. Patent 268,476, December 5, 1882, Traveling Contact for Electric Railways.
12. The Siemens & Halske type of traveler ran on eight wheels on positive and negative wires. Concurrent with the Charlottenburg streetcar line, the Siemens firm—using the same current-collection system, operated a free-wheel vehicle, the Elektromote near the Hallensee railway station in Berlin. U.S. Patent 270,186 for an Electric Vehicle, was issued to Joseph R. Finney on January 2, 1883. It was obviously a copy of the Elektromote.
13. The Siemens & Halske slotted-tube overhead system was first used on the Paris Exhibition line in 1881. It was applied to the Mödling-Hinterbrühl light railway, opened in October 1883 (Vienna, Austria), and the Frankfurt-Offenbacher Trambahn, opened in April 1884. Current-collector switching could be accomplished with this system. Both lines cited retained their slotted-tube overhead construction for more than twenty years.
14 *V.D.*, p. 11.
15. U.S. Patent 424,695, Suspended Switch and Traveling Contact for Electric Railways. The principle was covered in U.S. Patent 334,062, Overhead Conductor for Electric Railways, issued to Van Depoele on January 12, 1886.
16. *D.T.*, September 7, 1887.
17. *D.T.*, December 21, 1887.
18. *D.T.*, September 14, 1887.
19. *N.H.D.P.*: January 20, March 23, 1888; *S.R.J.* 4 (May 1888): 131; *Street Railway Gazette* 3 (June 1888): 82: "The equipment at the power station consists of a 175 h.p. Manning boiler, a 125 h.p. Hewes and Phillips' Corlis engine and a 100 h.p. Van Depoele generator and exciter."
20. *N.H.D.P.*, May 1, 1888. See Appendix 2; *AERA* (American Electric Railroad Association) 5 (December 1916). *Early Van Depoele Installations*, an interview with Elmer P. Morris,

quotes another account of the line's opening from "a faded clipping from a New Haven paper" (in Morris's possession) pp. 504-06. (hereafter cited as A.E.R.A.).
21. Scrapbook, Derby Public Library. Undated newspaper clipping, "The car barn at that time was at the J. G. Curtiss stables, opposite the present Capitol Theater."
22. *The Evening Sentinel*, Ansonia, September 27, 1935. An article identifies the individuals in the picture: "George R. Fosdick, sr., of Winchester, New Hampshire, who was the motorman of the car when the picture was taken, happened to be visiting in Ansonia last week and saw the picture. Mr. Fosdick identified all in the photo excepting the barefoot boy. The motorman, standing on the front step of the car with his arms folded, is Mr. Fosdick himself, as he looked on the job 47 years ago. In the group beside the trailer are Louis Turgeon, the brakeman of the car, standing in overalls; Milton Morgan, then clerk in the office of the railway company; behind him B.W. Porter, then superintendent of the Ansonia, Derby and Birmingham electric motor line; William Hawkins, manufacturer of the famous Hawkins skates, standing with a straw hat and hand extended towards the cargo, and George Kennedy of Port Chester, N.Y., foreman of the road, standing, arms akimbo, wearing a dark shirt and straw hat."
23. *D.T.*, August 3, 1887.
24. Note by the late Harry Hall states that "Car No.4, originally a horse car purchased in July 1887, from the Fourth Ave. Co. of New York, which was one of Jake Sharpe's old cars that he put on the Broadway line after putting his track down in one night."
25. Brill order No. 1703 "3—12 foot electric cars Van de Poele, Derby HRR"; No. 1753 "1 gondola, 4 wheel with 4 x 5 rim"; No. 1754 "1 flat, 4 wheel 10 feet long"; No. 1755 "1 box, low"; No. 1756 "2 rocker dumps."
26. *N.H.D.P.*, January 7, 1888.
27. *N.H.D.P.*, March 24, 1888.
28. *N.H.D.P.*, April 25, 1888.
29. U.S. Patent 324,899- Electric Railway, Aug. 25, 1885. Other Van Depoele patents for electric braking systems are: U.S. Patent 352,167- System of Motors for Electric Railway Brakes, November 9, 1886; U.S. Patent 367,685- Electro Magnetic Railway Brake, August 2, 1887. *Hartford Daily Times* account appeared on May 23, 1888. Quoted in Harte (see n. 3 and Appendix 3).
30. *Telegraphic Journal and Electrical Review* 22 (June 8, 1888): 629.
31. *D.T.*, November 13, 1889.
32. Pullman Palace Car Co. order book entry for electric locomotive. Reference supplied by George Krambles.
33. *A.E.R.A.* 5 (1916): 489.
34. *Hartford Daily Times*, Hartford Conn., May 23, 1888. Quoted in Harte (see n. 3, and Appendix 3).
35. *N.H.D.P.*, May 2, 1888.
36. *N.H.D.P.*, May 10, 1888.
37. *N.H.D.P.*, June 2, 1888; *D.T.*, June 13, 1888.
38. *N.H.D.P.* and *D.T.*, June 13, 1888.
39. *D.T.*, August 1, 1888.
40. *D.T.*, November 7, 21, 1888.
41. *D.T.*, December 5, 1888.
42. *N.H.D.P.*, December 1888.

43. *S.R.J.* 4 (1888): 335; 5 (1889): 15.
44. *New Haven Register,* April 11, 1889.
45. Brill order No. 2094: "1—12 foot car like 1703"; *D.T.,* November 7, 1888.
46. *N.H.D.P.,* November 16, 1888; *S.R.J.* 5 (1889): 98.
47. *D.T.,* February 20, 1889.
48. *D.T.,* April 3, 1889.
49. *D.T.,* April 24, 1889.
50. *D.T.,* November 6, 1889.
51. *D.T.,* November 27, 1889.
52. Brill order No. 2707: "alterations to 2—12 foot cars, elec. Derby H.R.R. Co."
53. *D.T.,* February 26, 1890.
54. *N.H.D.P.,* June 21, 28, 1888.
55. *D.T.,* December 5, 1888.
56. *D.T.,* September 11, 1889.
57. *D.T.,* December 18, 1889.
58. *D.T.,* February 19, 1890.
59. *D.T.,* November 13, 1889.
60. *D.T.,* December 4, 1889.
61. *D.T.,* February 26, 1890.
62. *D.T.,* April 4, 1888.
63. *N.H.D.P.,* May 2, 1888.
64. *N.H.D.P.,* May 15, 1888.
65. *N.H.D.P.,* May 22, 1888.
66. C.R.H. p. 5: "The track and overhead was ready for operation May 1st, 1888, and on that date the line was opened, but not with the big motor. Some one had blundered, and its roof was too high to let it go under a low bridge near its objective, the steam boat dock. The necessary changes were under way, however, and on July 1st it too went into operation. The roof had been dropped two feet; the frame carrying the trolley pole hinged and braced so it could be laid flat on the roof, and to give the operator room, the floor at each side of the motor was dropped a foot . . ."
67. *N.H.D.P.,* June 16, 1888.
68. *N.H.D.P.,* July 28, 1888.
69. *N.H.D.P.,* November 15, 1888.
70. *D.T.,* June 19, 1888.
71. *D.T.,* September 25, 1888.
72. *New York, New Haven & Hartford Railroad,* official correspondence, in the collection of Mr. Dave Peters, Sr.

Highlights in the Development of Electric Railways, 1842-1907

Summer 1842
Robert Davidson operated an experimental battery-powered car on a section of the Glasgow-Edinburgh railway.

April 1851
Prof. Charles G. Page operated an experimental battery-powered car on Baltimore & Ohio Railroad track between Washington and Bladensburg, Maryland.

May 1879
On Ascension Day, Messrs. Chrétien and Felix successfully plowed a field at Sermaize, France using two Gramme electric motors, each on a self-propelled wagon, and supplied with power from dynamos at some distance. The wagons moved along opposite sides of the field, drawing a reversible plow between them by means of cables.

May 1879
Siemens & Halske (Ernst Werner von Siemens) operated a locomotive-hauled passenger train on a loop of track at the Berlin Trade Exhibition. First public operation of an electric railway. 52 cm. gauge, center third rail power supply. Locomotive preserved at the Deutsches Museum, Munich.

May 1880
Thomas Alva Edison operated an experimental electric locomotive on a track at his Menlo Park, New Jersey, laboratory. The track was extended to three miles in length. In 1882, Edison built a new track on which he operated a passenger and a freight locomotive. 42-inch gauge. Positive and negative running rails. The 1880 locomotive is preserved in the Menlo Park compound at Greenfield Village, Dearborn, Michigan. The running gears of the two 1882 locomotives are preserved at the Edison National Historic Site, West Orange, New Jersey.

May 1881
Siemens & Halske built the first electric railway between the railway station at Gross Lichterfelde and the Prussian Military Academy. Positive and negative running rails. The line was entirely on prive-right-of-way. Meter guage.

1881
Siemens & Halske operated a double-deck electric car on street trackage at the Paris Electrical Exhibition. Positive and negative slotted tube collectors were used. The contact bobbins were trailed by the car. This was the first electric railway to use an overhead power supply. Standard guage.

March 1882
A narrow-gauge electric railway was built at a linen bleachery near Lisieux, France to transport the cloth to and from the bleaching fields. A Siemens motor was used, powered by batteries carried on a trailer.

April 1882
Siemens & Halske converted a horsecar line to electric operation using twin overhead wires on which ran an eight-wheeled traveler, connected to the streetcar with a flexible cable, Charlottenburg-Spandauer Bock (Berlin). Concurrently, in nearby Halensee the same overhead system was used to power a free-wheeled vehicle, the "Elektromote"—the progenitor of the trolley bus.

In America at very nearly the same time, Dr. Joseph R. Finney of Pittsburgh patented a similar traveler to supply power to an electric streetcar, and also the use of the same device to supply power to a free-wheeled vehicle.

August 1882
Siemens & Halske equipped their first industrial electric railway, in a coal mine at Zaukeroda, Saxony. 52-cm. gauge. Overhead power supply consisted of twin inverted "T" rails. Small grooved wheels on collectors engaged edges of flanges and were trailed by flexible cables. An original locomotive is preserved in the Siemens Museum in Munich. It is noted that the 1879 locomotive of Siemens was designed as a mine locomotive.

1883
Schuckert & Co. equipped an industrial railway in a lumber yard at Brannenburg, Bavaria. Overhead conductors consisted of positive and negative angle-irons set back-to-back and spaced apart. They were suspended from bracket arms attached to trackside poles. Current collection was by means of under-contact brushes with spring pressure against the conductors. The first use of under-contact current collection. Both Van Depoele's and Sprague's original concepts for under-running collectors, as shown in their patent drawings, were similar to the Brannenburg installation.

June 1883
The Electric Railway Co. of the United States, representing the interests of Stephen D. Field and T. A. Edison, built an electric railway around the gallery of the exhibition hall at the Exposition of Railway Appliances, held in Chicago. The locomotive, THE JUDGE drew a trailer. Center third-rail power supply; negative return through running rails. (Running rail negative current return is inferred in subsequent entries unless otherwise specified) 36-inch gauge.

August 1883
Magnus Volk built an electric railway along the beach front at Brighton, England. A Siemens dynamo (which has been preserved) powered the line and was driven by a gas engine. The cars' motors were built by Volk. Positive and negative

running rails. 24-inch gauge. The line was rebuilt to 32-1/2-inch gauge in 1892, and with off-center third-rail power supply. It is still operated seasonally.

September 1883
Charles J. Van Depoele electrically equipped a demonstration suspended-elevated railway car that was run in the exhibition hall of the Chicago Inter-State Fair. The running gear was on top of the car body, which was suspended below the track structure. Positive and negative conductor wires were used; the collectors were two grooved wheels mounted on a sprung plank fastened to the car roof, and pressing against the underside of the wires.

September 1883
Siemens Brothers equipped the Giants Causeway Tramway with the world's first hydro-powered generating plant. Line operated between Portrush and Bushmills, Northern Ireland. 36 inch gauge. Side third-rail power supply.

October 1883
Siemens & Halske equipped a suburban electric passenger railway between Mödling and Hinterbrühl, near Vienna, Austria. Meter gauge. On private right-of-way. Slotted-tube overhead, positive and negative conductors.

November 1883
Leo Daft operated his experimental electric locomotive, AMPERE, on 1¼ miles of electrified track of the Saratoga, Mt. McGregor & Lake George Railroad, hauling a double-truck passenger coach. In spite of the derailment of the locomotive on one trip, it otherwise performed well. Third-rail power supply. 36-inch gauge.

April 1884
Siemens & Halske equipped an electric street railway, Frankfurt to Offenbach, using identical equipment to the Austrian line last cited. Both of these lines continued to use the original technology into the early 1900s. Original motor car and trailer, and overhead fittings preserved in the Frankfurt Transport Museum, West Germany.

July 1884
Bentley & Knight equipped the first American electric street railway in East Cleveland, Ohio. It operated for one year before reverting to horse traction. Shallow conduit power supply caused many problems. Standard gauge.

September 1884
Charles Van Depoele equipped an electric railway at the Toronto Industrial Exhibition. A locomotive pulled (and pushed) three open trailers. A central box conduit was used, with positive and negative conductors. In 1885, the line was extended to the terminus of a city streetcar line, and the locomotive was equipped with an underrunning current collector, the power supply being changed to an overhead wire. A grooved wheel on the end of a pivoted arm was

held in contact with the wire by spring tension—the first "trolley pole." The original device is preserved by the Museum of Science and Technology, Ottawa, Canada. Later, in 1885, Van Depoele used the same current collection system on an electric railway at the Northern Central and South American Exposition, held in New Orleans.

1884-1885
John C. Henry operated an electric streetcar at Kansas City, experimenting with overhead power collection. His "traveler" had horizontal grooved wheels engaging the sides of the wire. He used a Van Depoele motor, with a drive through differential gearing. He subsequently built lines for public operation in Kansas City and San Diego, California.

August 1885
Leo Daft equipped a branch streetcar line in Baltimore for electric operation, using electric locomotives to pull horsecars. Third-rail power collection. In January 1886 an overhead conductor was installed at road crossings. A form of forked trolley pole with sliding contact was used as a current collector at these locations. It was raised and lowered by the motorman by means of levers within the locomotive cab. 64½-inch gauge.

September 1885
Holroyd Smith equipped the Promenade tramway in Blackpool, England, for electric operation using conduit power supply. Standard gauge. Oldest electric line in continuous operation. Overhead wire power supply adopted in 1897. An original car is preserved at the National Tramway Museum, Crich, England. It was operated in Blackpool on the centennial of the opening of the line.

October 1885
Mather & Platt of Manchester, England, equipped the Bessbrook & Newry Electric Tramway in Northern Ireland. Single-ended, double-truck locomotive cars carried passengers and hauled special road-rail freight cars. There were loops at each end of the line. 36-inch gauge. Center third-rail power supply used, except at a wide, angular road crossing, where an overhead wire was used. Current collection at this crossing was by an early version of a bow collector patented by Dr. John Hopkinson. One of the two original motor cars ran until the closing of the line in 1948 and is preserved in the Belfast Transport Museum.

1886-1887
There was little electric railway construction in Europe in this period. In North America, the electric railway pioneers equipped a number of small lines that had varying degrees of success.

June 1887
The Van Depoele Electric Mfg. Co. equipped the first citywide electric streetcar system in Montgomery, Alabama, after a years' experimental operation of two

cars on one line. This was the first large-scale use of the under-contact trolley wheel mounted on the end of a sprung trolley pole. "Frogs" attached to the overhead conductor above track switches permitted the trolley wheel to follow divergent lines. Single-end cars were used, with the motor mounted on the front platform and a chain drive to the front axle. Turntables were used to reverse the car's direction. 48-inch gauge.

February 1888
The Sprague Electric Railway & Motor Co. (Frank J. Sprague) equipped the Richmond Union Passenger Railway Co. (Virginia) for electric operation. The trolley arrangement was similar to Van Depoele's, but the trolley poles were reversible. The cars were double-ended with the two motors under the floor. Standard gauge. The first electric street railway embodying mature design and operational principles, and the precursor of a wave of street railway electrification. Within a few years, most street railway mileage in the U.S.A. was converted to electric operation. One of the original (and unsuccessful) single-reduction motors used in Richmond is preserved in the Ford Museum, Dearborn, Michigan.

July 1888
The world's first standard-gauge electric freight locomotive was put into service on the Derby Horse Railway, between the Derby Dock and Ansonia, Connecticut. The electrification of this line was commenced by the Van Depoele Electric Mfg. Co. and completed by the Thomson-Houston Electric Co., which had taken over the railway business of the first firm. The locomotive is preserved at the Shore Line Trolley Museum, East Haven, Connecticut.

November 1890
Mather & Platt equipped the City & South London Railway, the world's first electrically operated "tube" (subway) line. Passenger cars were drawn by electric locomotives. Standard gauge. Off-center third rail. An original locomotive is preserved at the Science Museum, London.

1891
The Thomson-Houston Electric Co. supplied a 100-horsepower electric locomotive to the Whitinsville Machine Co. in Massachusetts, where it was used to shift standard freight cars from a steam road interchange into the plant. Current collection was by a pantograph with wheel contact—a Van Depoele patent design.

1892
The Thomson-Houston Electric Co. constructed a thirty-ton electric locomotive, the largest built up to that time. Considered to be the first electric locomotive constructed by the General Electric Co., which was incorporated in April 1892 with the consolidation of the Thomson-Houston Co. and the Edison General

Electric Co. It was designed to replace steam locomotives on New York's elevated railways. It was exhibited at the Chicago World's Fair in 1893, and in 1896 sold to the Manufacturers Railway in New Haven, where it was used until 1905. It is preserved at the National Museum of Transport, St. Louis, Missouri.

January 1893
The Liverpool Overhead Railway was the first electrically operated elevated railway. Equipped by the Electric Construction Corp. Ltd., of Wolverhampton, England. Permanently coupled pairs of cars had a gearless motor in each end truck. Central third-rail power supply. Standard gauge.

1895
The General Electric Co. electrified the Baltimore & Ohio's Howard Street Tunnel in Baltimore—the first electrification of a main-line steam railway. Slotted-box conductors were used; the collector bobbins were connected to the locomotive with a pantograph arm. This arrangement was similar to the slotted-tube conductors first used by Siemens & Halske at the Paris electrical exhibition in 1881.

May 1896
Siemens & Halske equipped the Budapest subway line, the first to use self-propelled cars. Overhead wire power supply, current collection by a form of bow collector.

April 1898
Frank J. Sprague invented the multiple-unit system for the control of a number of independently powered electric cars from the lead car, and first used on the South Side Elevated Railroad in Chicago. The equipment was manufactured by the General Electric Co. to Sprague's designs. An original car is preserved by the Chicago Transit Authority.

July 1899
Brown, Boveri & Co. equipped the first standard railway in Europe with alternating-current traction power between Burgdorf and Thun, Switzerland. 40 cycle, three-phase, 750 volts AC. Double wire overhead with twin bow collectors. The two original locomotives are preserved, one at the Deutsches Museum in Munich, the other at the Swiss Transport Museum, Lucerne.

October 1903
AEG (Allgemeine Elektricitäts-Gesellschaft) and Siemens & Halske experimentally equipped the military railway between Marienfelde and Zossen (near Berlin) to study the possibilities for high-speed electric passenger service. On October 28, the AEG-equipped car achieved a speed of 131 miles an hour. 10,000 volts AC, three-phase. Three-wire power supply with wires in vertical plane.

1906-1907

The General Electric Co. equipped the main-line electrification of the New York Central & Hudson River Railroad from High Bridge/Williamsbridge into Grand Central Terminal. The need for electrification was demanded by the construction of the Park Avenue tunnel and the resulting problems with smoke from the steam locomotives that used it until electric operation was instituted, using electric locomotives and multiple-unit passenger cars. The electric operation was later extended to Harmon/North White Plains. 600 volts DC. Side third-rail with under-contact collector shoes. The prototype locomotive was built in 1904, and the rest of the original series were delivered in 1906. Three locomotives have been preserved: the prototype machine by the Mohawk and Hudson Chapter of the National Railway Historical Society at Schenectady, and one each by the National Museum of Transport at St. Louis, and the Shore Line Trolley Museum, East Haven, Connecticut.

July 1907

The Westinghouse Electric Co. equipped the first large-scale main-line electrification in the United States, for the New York, New Haven & Hartford Railroad between Grand Central Terminal and New Rochelle, New York. Extended later in the same year to Stamford, Connecticut (ultimately to New Haven). 11,000 volts AC, single phase. Catenary power supply with pantograph collectors. On track shared with the New York Central, 600 volts DC used with side third-rail. Electric locomotives used, and also multiple-unit passenger cars.

Appendix 1

Extracts from the contract between the Van Depoele Electric Manufacturing Company and the Derby Horse Railway Company, as quoted in *The Van Depoele Electrification of the Derby Horse Railway Company 1888—Connecticut's First Electric Railway.* An unpublished paper written by Charles Rufus Harte (undated) in the Engineering Societies Library, New York.

> One 100 horse power Generator with Exciter complete. One 75 horse power motor. Three 12 horse power Motors. One Motor car and Three 12 foot closed passenger cars with enclosed fronts. Fare box and Sliding doors as per specification, to be furnished by J. G. Brill & Co., the said Generator to be set on foundation to be furnished by party of the second part, ready to be belted to; the Motors to be connected to cars with suitable gearing, sprocket wheels and belting, with one Traveler for each car; all the above to be complete and ready to run. Also to furnish and erect a copper conductor or wire, on poles erected by the party of the second part, and connected with Generator all complete and ready for work. Also to furnish and light the said passenger cars with Incandescent Lamps the same as done on the line equipped by the party of the first part in Scranton, Pa.

[and guaranteed that]

> All the said Electrical apparatus and equipment will be of first class workmanship, and that the Generator will be of sufficient capacity to run the three 12 foot passenger cars, carrying forty passengers each, at the rate of twelve miles per hour, and at the same time to run the large Motor car, hauling a load of thirty thousand pounds, at the rate of three miles per hour, and that all the Motors and Generator will be of sufficient capacity to do the work for which they are rated.

Appendix 2

New Haven Daily Palladium, Tuesday, May 1, 1888:

DERBY PEOPLE ARE HAPPY—THE NEW ELECTRIC ROAD HAS ITS INITIAL TRIP—SEVERAL GENTLEMEN TAKE A MIDNIGHT RIDE ON THE NEW ENTERPRISE AND EVERY ONE PARTICIPATING IS HIGHLY PLEASED AND SATISFIED.

From last night at eleven o'clock until one o'clock this morning, the inhabitants of Ansonia and Birmingham were in high feather in consequence of the completion of the electric railroad which has been for the last year or two Derby's chief lion and an institution the praises of which have been sounded throughout the country.

Last night the prominent citizens and members of the press were given to understand by the superintendent and other officers of the new corporation, the Derby and Ansonia railroad, that a trial trip would be had and it was hoped that everything would go off in good style. And it did, as the readers of the PALLADIUM will see. It is an unusual circumstance to start an electric road in this age of steam and horse power, which are the accepted means of propulsion on roads of that size. But the enterprising inhabitants of Derby made up their minds that they would give electricity a chance.

The Car and Motor Start

Just before eleven o'clock H. Holton Wood, the president of the road, was at the Ansonia depot with about thirty of the citizens of Ansonia and Derby ready to start on the trial trip of motor No. 2, which stood in readiness to go when the word should be given. It was a handsome cream colored four wheeled car, sixteen feet in length and handsomely upholstered. About four feet of the forward end of the car is partitioned off and in the compartment is situated the motor, of about three or four horse power. Besides the elect who were invited to take a ride on the new vehicle were about 250 men and boys, many of whom doubted whether the machine was going to make a successful trip down to Derby and back. The car was lighted by four incandescent lights in the interior and one in the rear end.

The Trip Begins

The car was under the control of Elmer P. Morris of Chicago, who has been intimately connected with the construction of the road. Only a little over one-third of the power was put in use, and the start was made in very fair style. The car ran rather slowly as it was not deemed expedient to let out all of the links of speed of which the machine was capable. So the boys to the number of fifty or seventy-five acted as a guard of honor, and they ran after the car as it went bowling along the track. They shouted and laughed and cheered in high glee, and were happy as kings. The motor soon struck a grade in which was a rise of five feet in 100 and around a curve of 200 feet radius. It went very smoothly and nicely. When it came to Miller's place the rise was seven feet in 100, and the car was stopped so as to prove that it could be easily started again. This plan was entirely successful.

Twelve Miles an Hour

Through Derby avenue a speed of twelve miles an hour was obtained and the trip down of three and three-fourths miles was made in about twenty minutes. When it arrived at the lower terminus it was then stopped for a while and then prepared for its return trip. On the return trip a slight delay was caused in consequence of the breaking of one of the cross wires. But this was of little moment for it was soon repaired and then the return trip was soon completed. When they arrived at the Farrel foundry they encountered a grade of eight and one-half feet in 100 and with a radius of seventy-five feet. It sailed up and around the curve in good shape. When the upper terminus was reached the car was turned about on its return to the place from which it started, which point was reached soon after midnight or very early in the morning of May 1, 1888.

The Trip A Success

Everybody that was awake and present at that time voted the trip an unqualified success. The boys were very proud of the new road and fired fire crackers to show their goodwill towards the new enterprise.

Among those who were on the trip were J. M. Emerson, editor of the Sentinel; W. A. White, M. J. Flaherty, also of the Sentinel and C. L. Case of the New Haven Palladium, Morris Drew, W. B. Blackman, W. W. Blakeman, George B. Clark, B. W. Porter and W. A. Moore of Freeport, Ill., J. G. Redshaw, Samuel Redshaw, Chief-of-Police Ellis, H. Holton Wood, John P. Wallace, George O. Schneller, J. B. Kennedy, superintendent, George Kennedy, foreman, Joel Wheeler, warden and Burgesses Drew and Redshaw, F. M. Drew, treasurer.

The charter of the road was granted three years ago and the cost is about $75,000. There are four motors on the road, three for passenger service and one large heavy one for freight.

Trips will be made today at irregular intervals and it will be several days before a regular time table will be made out. The trip exceeded the most sanguine expectations of all the parties concerned, and everybody in Ansonia votes electricity a big thing.

Appendix 3

A contemporary description of the operation of the electric cars on the Derby Horse Railway, extracted from *The Hartford Daily Times,* May 23, 1888, and quoted in *The Van Depoele Electrification of the Derby Horse Railway Company 1888—Connecticut's First Electric Railway,* an unpublished paper written by Charles Rufus Harte (undated) in the Engineering Societies Library, New York.

Source of the Propelling Force

Near the Derby Dock is the "power station," a large brick building. It contains an engine of 150 horse-power, and an upright boiler to match. The only other machinery is an "exciter" and a "generator" of 100 horse power.

An exciter is a small dynamo, "series wound," that is to say, the armature and field magnets are wound, in series with each other, with covered copper wire. This exciter, being driven by power from the engine, furnishes the current, producing magnetism in the field magnets of the large generator. And the armature in the large generator, also driven by power from the engine, produces the current of electricity used on the line for driving the cars. This armature being connected in "multiple arc," it at no time generates a greater current than is being utilized on the line. No "resistance boxes" or paraphernalia of any sort are used. It may be plainer to say that the power transmitted is according to the number of cars in operation.

The Electric Circuit

Everybody knows that in electric lighting systems there must be a circuit established in order to get any force from electricity. So there must be a circuit in order to transmit electric power. And though there are several methods of securing a circuit for street railways, mention will now be made only of the one in use on the line in question.

The outgoing current runs through an overhead wire, and the return current comes through the rails. The overhead wire is copper a half an inch in diameter. It is suspended at a height of about sixteen feet above the rails, all along the line. At each 100 feet on the line, two poles, one on each side of the street, hold a cross wire, in the center of which is a porcelain insulator. To this insulator the copper wire is attached. The cross wires are, of course, drawn very tight to support the weight of the overhead wire running at right angles to them. This wire runs directly over the center of the track, and, also, similarly in the case of all sidings, or switches. For, the same method of transmitting the electric force to the car motor on one track must prevail in all. Where sidings or switches occur in the track they occur also in the overhead wire. Each works automatically.

The return current comes through the rails. Therefore a perfect metallic circuit is absolutely necessary. The rails are the ordinary street car rail, and in order to make the connection absolute a copper plate is placed beneath each joint where two rails come

together. The usual allowance for expansion and contraction at the ends of the rails is provided, because the circuit depends upon the copper plates, bolted down under the rail ends, rather than upon the ends of the rails coming together.

The outgoing current starts from the large generator, and the return current comes into it, thereby making the circuit perfect.

The Motor Cars

An ordinary street-car, with slight expense, can be changed into an electric car. All that there is to do is strengthen the front platform so as to stand the extra weight of the motor. To this end two strong beams are run through the whole length of the car and in the center of it; besides these central beams, the ordinary beams are placed on either side of the bottom frame of the car, and, with the central beams, receive the flooring of the platform. The distance between the central beams is such that the motor sits right on top of them, the motor being held from moving sideways by means of strong side-bars. The motor is further provided with a strong screw placed in front of the latter and held fast on the front cross beam. This screw allows the motor to be pulled forward so as to tighten the link-belt if necessary.

The connections between the motor and the axle of the car are made thus: To the motor shaft is affixed a pinion, meshing into a larger gear; this gear is mounted upon a steel counter shaft, carried by broad bearings solidly fixed to the bottom of the motor, so that the center of the motor shaft remains always true with that of the counter shaft; and on opposite ends of the counter shaft are placed two sprocket wheels communicating motion to two other sprocket wheels of larger size, placed upon the front axle of the car. The connection between the two sets of sprocket wheels consists of steel chain made especially for the purpose; the chain is practically noiseless and wears but little. This class of chains are evidently the best to use for street cars since they are flexible and positive; the oscillations and motion of the body of the car do not in the least interfere with the gearing. Only the front axle is connected with the power, the hind wheels merely rolling. This is said to be warranted by experience. It seems that it is impossible to have or to keep both pairs of wheels of exactly the same diameter, so whenever they are both connected this difference will show itself at once; one pair of wheels will have to slip to accommodate themselves to the other, thus taking an unnecessary amount of driving power, besides the cost of chains and wheels.

All the gearing is boxed in carefully so as to protect it from dust and injury, and at the same time render the motion of the gear inaudible.

The motor cab takes about three feet of the end of the car and is separated completely from the passengers by a partition of wood and glass. The motor being in the center, a man on each side of it can sit comfortably. The motors used in the Ansonia cars are of 15 horse-power each, and only one man is needed to a motor.

How the Cars Are Run

The reader may think he has not yet learned how electricity moves the car, and this is of interest, certainly. The outgoing current in the overhead wire is transmitted to the motor in the car, and thence also through the rail back to the generator whence it came. This circuit is uninterrupted, or the car stops; that is, if the connection be not broken, sufficient force is constantly transmitted to drive the car.

On the roof of the car is an upright bar, perhaps an inch and a half square and two feet and a half high. At the top of this upright is fastened another, perhaps six or eight feet long, but known as an arm. So far as the upright and the arm are connected, they resemble the old-fashioned well-sweep. The upper end of the arm bears a deeply grooved wheel, which fits the half-inch copper wire overhead, and from the nature of its work is called the "traveler." This traveler seldom leaves the wire, but whenever it does it is replaced immediately by pulling it down by a cord and slowly releasing it upward.

At the lower end of the arm is a set of springs for the purpose of pressing the traveler upward and against the overhead just evenly enough to make it run smoothly. For instance, though the overhead wire is intended to be at a uniform height above the car, suppose it is higher, the springs raise the traveler end of the arm upward as far as is necessary to follow the wire. Suppose it sags; then the traveler end of the arm is depressed and the springs at the lower end of the arm extended. Thus uniform pressure and sure connection by the grooved traveler against the overhead wire are always secured.

The current comes from the wire and through the traveler arm and upright, to the ceiling of the cab. From the bottom of the upright the current is conveyed by a copper wire inside a flexible rubber tubing. A switch, on the ceiling of the cab, connects the wire from above with a similarly insulated wire running down the rear partition of the cab and into the motor. This switch is the only legitimate means of breaking the electric current.

The Motors

The motors used in the passenger cars are of 15 horse-power each. The machine is extremely simple and can be taken apart in a few minutes. All parts are accessible so that it is easy to keep everything in good trim. There are two pairs of commutator brushes of copper, in each motor, and by means of a hand lever two parallel bars are made to place either one or the other pair upon the commutator, thus enabling the operator to run the motor backward or forward. If it is desired to run fast, you turn the main handle higher up to the vertical; and the reverse for running slow, that is, turn the handle down toward the horizontal line of the center of the motor.

A hand switch is placed on top of the motor, by means of which more or less current can be passed through the motor, and thus regulate the power and speed thereof. Heretofore, for propelling street cars, a resistance box, or rheostat, has been placed in circuit with the electric motor in order to regulate speed and power. In the Van Depoele rheostatic motor the resistance coils are simply wound round the field magnet cores and over the ordinary field coils or helices, forming the electro-magnet.

Therefore, on starting the motor with a heavy load, the extra current required passes through the rheostatic coils of the fields of the motor and gives stronger magnetism in the motor; consequently receiving more power just when it is wanted. The motor, on being started, increases its speed, and gradually the rheostatic coils are cut out when the motor has attained its maximum speed. This mode of regulation is very likely the most perfect, especially where a large number of motors are to run from the same source. Every motor is so proportioned that it can only take its part of the current, and thus not interfere with the other motors in the circuit; and at the same time, it is unable to take more current from the source than it needs.

One advantage of this rheostatic motor is the ease with which the car is controlled. For instance, when you desire to go up a hill, all you need to do is to let the current pass through

the rheostatic coils until the top is reached. The extra magnetism thus produced in the motor will give a much stronger pull and bring up the load with ease, though at a reduced speed, of course. The governing of the motor is entirely electrical instead of mechanical.

When the driver desires to handle any integral part of the motor, he switches off the current; for, should he neglect to do so, the chances of receiving a shock would be plenty.

Within arm's reach of the driver as he sits in the cab, is an upright lever with which the brake is connected. He rises to his feet to handle this, which is indeed powerful; but if he desires to make a quick stop, he reaches from this lever with his left hand and grasps another, also within easy reach, holding both simultaneously. The switch in the motor having been turned off by a single motion of the hand on the handle of the box surmounting the motor, the wheels cannot roll and the car suddenly comes to a standstill. To start again, the brakes are released, the handle is turned round to connect the current with the armature, and the car responds.

Electric Lights in the Car

Incandescent lights are furnished for the car from the same source of supply, the power station. The smaller current is received from the main current overhead, and a little switch in the cab is worked by the driver. While the Times representative was aboard one of these cars, it stopped about half way between Derby and Ansonia. The driver realized that there was a letting-up of current. He turned off the switch of the motor and turned on the electric light switch, but the lights did not show bright. He left the switch on, and remarked that as soon as the main current was restored the lights would show up white. In a few minutes they became white, and the motor was again put in operation. It was later learned that the engine had stopped for a few minutes because of disarranged oil-cups. The driver can test the strength of the current at any time by switching on his electric lights. Stations and other places along the line can be lighted in the same way from the common source.

Speed Attained

These 15 horse-power motor cars have a maximum speed of about twenty miles on a level track. They can be run as slowly or as fast, in that limit as desired. The custom is to make a speed of a mile in five minutes, which is indeed rapid transit.

On a level stretch between Derby and Ansonia Mr. Morris, the electrician of the Van Depoele Company, crowded the car up to a rate of fifteen miles an hour. A sudden stop was made, both brakes being applied. This was done in fifty feet, and not a disagreeable motion in the nature of a jerk occurred! Had not the reporter actually experienced this he would scarcely have believed it. Neither at starting nor at stopping, was there any jerking, so common to horse cars, though it was naturally looked for.

The average mileage of a horse car is fifty-six miles a day; that of an electric car is ninety.

Besides its own car a 15 horse-power motor can draw one other car, accommodating in all from fifty to seventy passengers, and maintain a speed twice that of four horses. More cars can of course be added, but the speed will be lessened proportionately, and this only on roads having no heavy grades.

Appendix 4

Gillespie, Charles B.
Souvenir History of Derby and Shelton, *Evening Transcript,*
Derby, January 1896

The Derby Street Railway Co.

The Derby Street Railway Company was organized in 1887, and began the construction of its tracks that summer, but owing to numerous delays was not in operation until April, 1888, being the first electric road in operation in New England. The road was equipped with the Van Depoele system, the cars being single ended with the motors placed in a cab on the front platform. The equipment consisted of three passenger cars, a freight motor and a half dozen freight cars. The line at that time was built to Derby Docks, where the power station was situated, and where the freight was transferred to the steamboat line then running to New York.

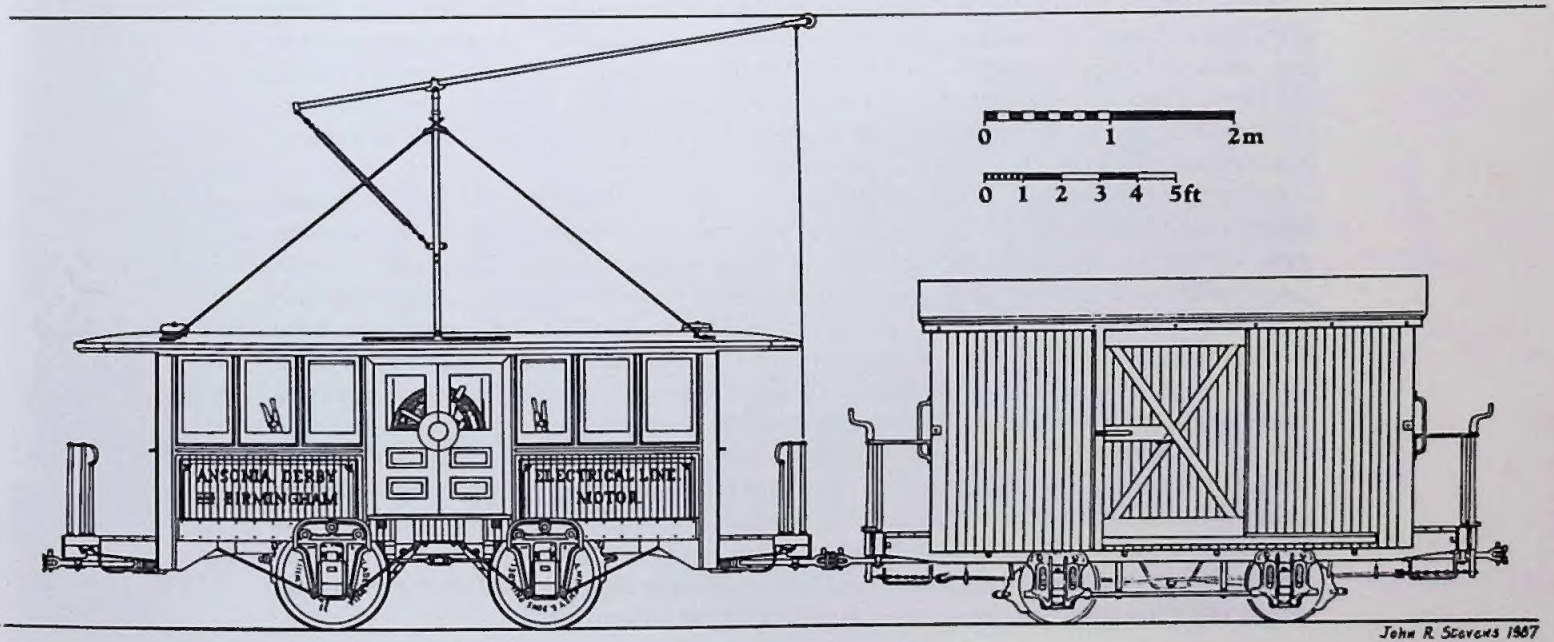
It was the anticipation of the builders of the road, that the freight business would be the important and paying part, but after two years experience it was found that, in the experimental condition in which electric railroading then was, it was impossible to handle freight profitably that way. The freighting was therefore given up, and the track from the docks to the Naugatuck R.R. Station was taken up. The passenger line at that time extended from the office of Wallace & Sons, Ansonia, to the foot of the hill on Main Street, Derby, while on the west side of the river a horse car road ran from the Naugatuck station to Ansonia, paralleling a portion of the electric road track in both places.

The horse car road went into the hands of a receiver soon after the electric road was started, and in 1889 its track and franchises passed into the control of the electric road. The track was taken up, and except for an extension of the line in Derby to the opera house, no material extension was made until 1894. The passenger business of the road had, however, increased materially in the meantime, and the cars which originally ran every half hour now ran every fifteen minutes.

In 1894 the tracks were extended over the lines of the old horse road through Derby on the west side to Ansonia, completing the belt line, and the service between the two places was brought down to every seven and a half minutes. In the same year the new and complete power station back of the car house in Derby was built. In 1895 a branch line was built from Derby up the Housatonic river to Lake Housatonic Park.

The Derby Street Railway Company can fairly claim that it now has as complete and well equipped a property in all respects as that of any other road in a place of similar size. Its power equipment consists of three boilers, two Allis Chalmers condensing engines of 250 H.P. each, running two G.E. Multipolar Generators of 200 kilowatts each, which are directly connected to the engines. The rolling stock consists of twenty-five cars, ten closed and fifteen open, an electric snow plow, street sprinkler, etc. Lake Housatonic Park contains a handsome pavillion where band concerts, dancing and theatrical performances of various kinds are given during the season, while on the lake are launches, row boats and canoes, all run by the company. The baseball grounds are considered the best in the state, and the grand stand and bleachers have a seating capacity of about 3,000. The past season was a most successful one in every way, and the games between the local and visiting teams were unusually well attended for a place of this size.

The growth of the company's business may best be realized by the fact that in 1888 the mileage run by its cars amounted to 61,200 miles while in 1895 it amounted to 247,600, and that in 1888 the number of passengers carried was less than 177,000 while in 1895 it was 1,033,977. The officers of the company are H. Holton Wood, president; Chas. F. Bliss, vice-president; Chas. E. Clark, treasurer, and B.W. Porter, secretary and general superintendent.



Addendum

Among the papers of Charles Rufus Harte (Engineer of the Connecticut Co. for most of its existence) obtained by the Branford Electric Railway Association as part of the Harold Hall collection, there is a history of the Derby Horse Railway by Harte, that has only recently become accessible. Since this material was not available when the text of this publication was written, it is fortunate that it can be used as a supplement.

Mr. Harte's account defines the reason for the inception of the electric freight operation as principally being the discriminatory treatment, in terms of freight rates, being given the firm of Merritt Clark's Sons—and presumably others as well. The Clarks were coal merchants. In 1884, the Naugatuck Railroad took over of the New Haven and Derby Railroad, which also served the area, thus removing the competition. William J. Clark of Merritt Clark's Sons proposed the Derby Horse Railway primarily as a freight carrier to compete with the steam railroad. The State of Connecticut approved the charter on March 19, 1885. In the process of raising the money to build the line, H. Holton Wood, General Manager of the Staten Island Rapid Transit Co., was approached. He in turn asked the chief engineer of his line for advice as to motive power, and electricity was recommended. The electric line under construction in Scranton, Pennsylvania by the Van Depoele Electric Manufacturing Co., was cited as an example. William Wallace, the pioneer electric manufacturer in the United States (he supplied Thomas Alva Edison with the dynamo used by Edison for his first incandescent electric light experiments) was asked for his opinion on the use of electric traction, and Wallace enthusiastically endorsed it. The railway's charter was amended to this end on March 16, 1887. In April, Mr. Wallace, acting for the company, entered into a contract with the Van Depoele company. (See Appendix 1). The cost of the electrical equipment, including the setting of poles and rolling stock, was $20,225.00.

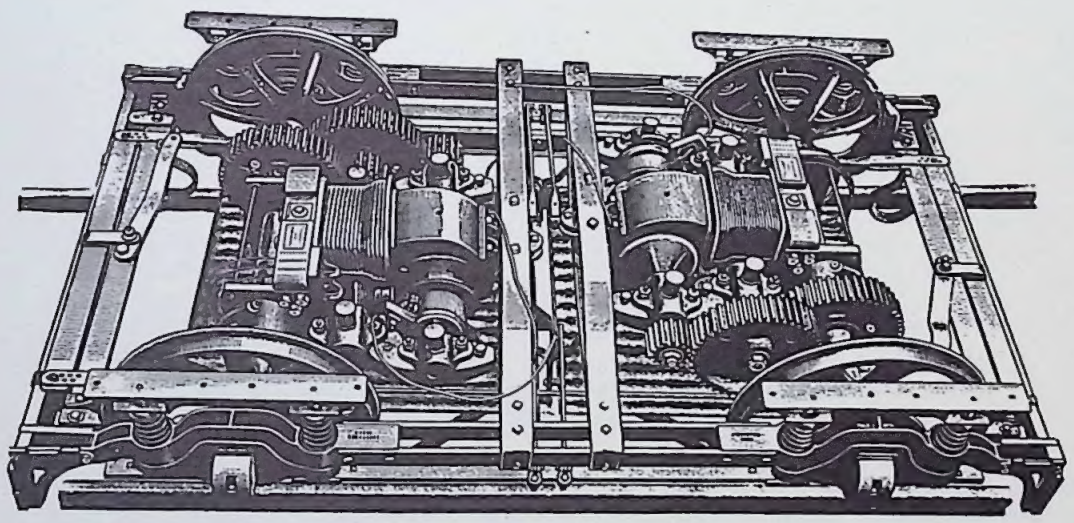
Much of Mr. Harte's account is directly quoted from remarks supplied to him in the winter of 1924-25 by James D. Kennedy then 70 years old, who superintended the construction of the line. Kennedy had performed the same role for the line in Scranton. Kennedy remained with the Derby Horse Railway until July, 1888, when he resigned to work for the Thomson-Houston Electric Co., then constructing an electric line in Lynn, Mass. Later he became Roadmaster for the Derby division of the Connecticut Co.

Kennedy remarked that sections of the track, in Ansonia and Birmingham were constructed with strap rails laid on longitudinal stringers. Mr. Kennedy was a hard-driving man, and the tactics used by him and his Irish laborers to beat out the Derby and Ansonia Horse Railroad Co., while humorous, would hardly be tolerated today. Where the two companies shared the same streets in Ansonia and Birmingham, Kennedy managed to have the Derby Horse Railway's track occupy the center of the roadway, thus forcing the other company to use the side of the road. Work on track construction in the disputed areas was started one night without advance warning, in order to obtain the preferred location. The first track laid was built to strategically block the other company. Stealth and lying were part of the procedure, and where this failed, resort was made to pickaxe handles! A group of 60 Italian laborers, coming from New York by steamboat to work for the rival company was intercepted, and ended up in Waterbury! Needless to say, Kennedy was successful in his efforts. He was also responsible for purchasing Car No. 4 in New York so that the line could be put in partial operation, before the completion of the power plant.

The Naugatuck Railroad was another adversary, and was the reason for building the electric line in the first place. The electric line had to pass under a low bridge of this railroad at the Derby Dock. According to Kennedy, to block it, the railroad narrowed the width of the passage, and also lowered it by installing deeper bridge timbers. As a consequence, when the locomotive was delivered, it was too high to pass through. Kennedy's statement that the locomotive was reduced in height by two feet is not credible, although some height adjustment was obviously made. Kennedy claimed that he designed the hinged "A" frame that supported the trolley pole, and also the "jumper" cable arrangement that permitted the locomotive to pass under the trestle with the "A" frame and the trolley pole laid flat on the roof. Kennedy commented on the locomotive's derailment problem, caused, he said, by lack of equalization of the axles. However, the locomotive has the same construction it had when delivered. He supplies no clue as to what was done to solve the problem of derailment.

Mr. Harte states that No. 4 was electrified, using a truck supplied on approval by the Thomson-Houston Electric Co. and equipped with F-30 double-reduction motors. This, Mr. Harte says, was the first motor that used the carbon brushes invented by Charles Van Depoele. The Derby Street Railway was impressed with its superior performance, and purchased motors and control equipment for all its cars at a cost of $9,000. Thomson-Houston paid $1,500 for the railway's Van Depoele equipment, but did not take the power house dynamo or the freight locomotive.

An article in the *Hartford Daily Times* of May 23, 1888 (quoted in part in Appendix 3) stated that when the construction of the electric line was announced, the two steam railroads serving the area issued a circular notifying manufacturers and merchants of Ansonia that they were reducing their rates by 25%. They had been receiving $1,000,000 a year for freight transportation. The article claimed that the electric line, only in operation a few weeks—and on which electric freight service had not yet begun—already had saved area shippers $250,000.



Thomson-Houston Electric Co. streetcar truck equipped with F-30 double-reduction motors, the first produced by the company that were equipped with the carbon brushes patented by Charles Van Depoele in 1888. *(C.B. Fairchild, Street Railways, 1892)*